

Popular Science®

The **What's New** magazine

\$1.50
JULY
1981

THE GREAT GASOHOL DEBATE

Monster tents

—computer designed
to replace buildings



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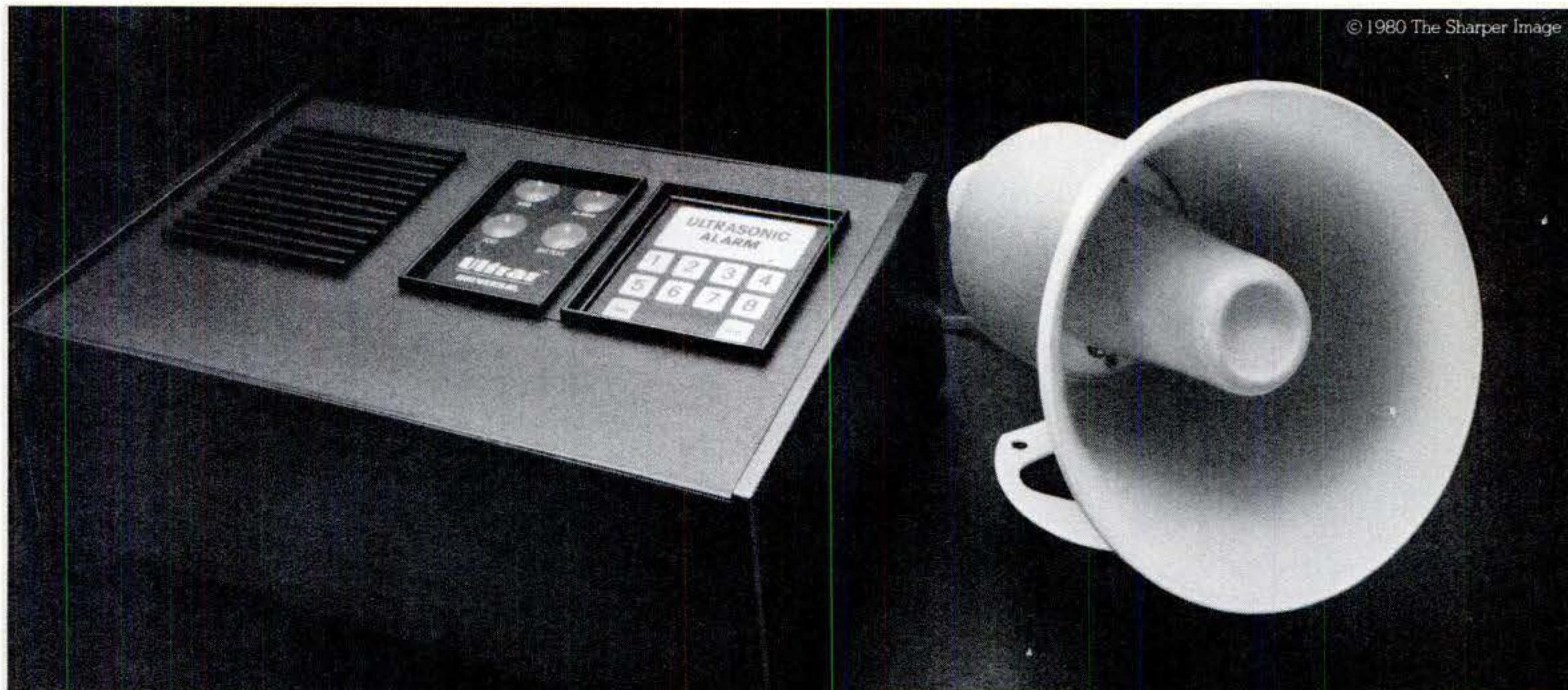
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Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

17 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Dec '79

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BUILD YOURSELF A FORTRESS. FOR THE PRICE OF A PEASHOOTER.

Today you can spend hundreds—even thousands of dollars—on a burglar alarm system. Or try to get by for a lot less, and wind up with one that doesn't do the job.

Well, now from Universal Security Instruments, Inc. comes Ultrar™, an economical alarm system that gives you many of the sophisticated features you normally find only with high cost protection. And it's available to you by mail from The Sharper Image.

Security. Only 5 minutes away.

Packed with professional features, this compact 10" x 7" x 3" system requires no expensive installation, wiring, or monthly rental charges. That's because it's fully portable. And all yours.

Ultrar uses a technology that even the smartest burglar can't fault—invisible ultrasonic (sound) waves that blanket a room as large as 600 sq. ft. with protection; and without falsing.

Remarkably, just a finger moving two inches will set it off; needless to say, the movement of an opening window or door will immediately activate the alarm (Ultrar is so sensitive, you'll need to remove pets from the room).

And you can set up the entire system in less than 5 minutes. Just by plugging it into a wall outlet and making a few simple adjustments.

If power should ever fail, or the unit be unplugged, Ultrar's built-in battery back-up is ready to take over (six C-cell batteries will provide months of service, if needed).

There's no guessing that it's working.

Ultrar is unique in being the only economical burglar alarm system that gives you a precise picture of the extent of its protection.

In its special Test Mode, you can actually walk through a room, open doors, try windows, etc., and watch your unit being triggered by these routine movements. During these tests, you get a clicking tone (with indicator light) that's less than one twentieth the volume of the regular alarm siren that's ready to greet any unwelcome guest.

This exclusive test feature insures proper placement of the unit, and the ideal adjustment of its sensitivity control.

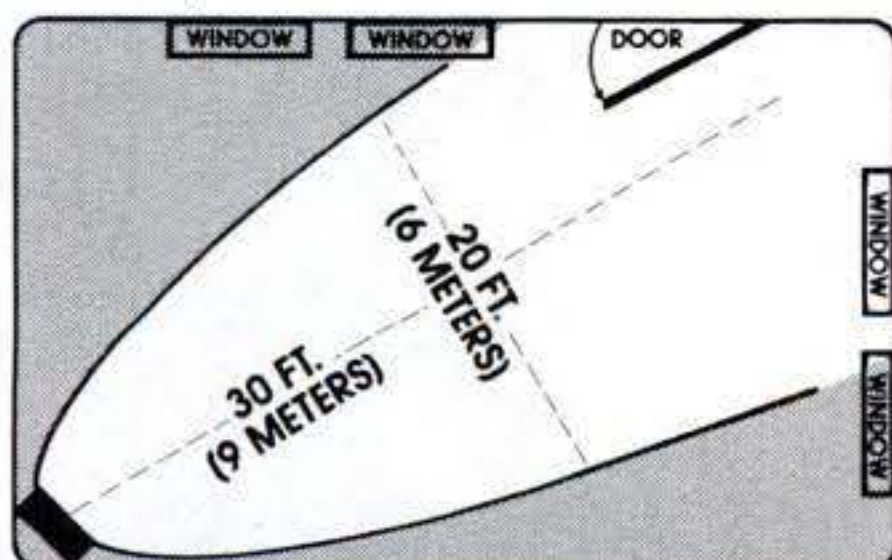
Now for the real thing.

Ultrar is armed with the press of a single button.

This same button activates a 60 second exit delay, giving you ample time to leave. And providing you with peace of mind—whether it's for an hour, or a two-month vacation.

If an intrusion does occur, Ultrar is programmed to do one of two things: (1) Surprise the intruder (and alert the neighbors) with a siren that can't be stopped—even by unplugging the

unit. (Once activated, the siren alarm continues for three minutes before automatically resetting itself in preparation for the next movement.) Or (2), it can be immediately disarmed, but only when you enter your secret 3-number code on its pressure sensitive pad.



Ultrar protects any room (up to 600 sq. ft.) with an adjustable cone-shaped ultrasonic shield. May be placed near a hallway, guarding access to all doorways.

The unit is also designed to wait 30 seconds after entry, giving you ample disarming time. And lets you know instantly, with the aid of a memory-assisted alarm light, whether or not the alarm was triggered while you were out.

The deciding factor.

The Sharper Image has been waiting two years to offer a reasonably priced protection system. And when we heard Ultrar's built-in 90+ decibel siren, we knew we had found what we were looking for.

We were further convinced by its external indoor/outdoor weatherproof speaker (50' cord and jack included), which enables you to extend this already piercing alert signal to the entire neighborhood—or make your inside warning sound twice as penetrating (system is available without additional speaker for \$20 less).

And we'll give you two full weeks to make up your mind. If for any reason you don't share our enthusiasm over Ultrar, please return it for a prompt, courteous refund. Includes 90 day warranty, warning decals, and full instructions.

ORDER NOW TOLL FREE.

For dual siren system, order product #246 for \$109. For Ultrar without the additional indoor/outdoor speaker, order #245 for \$89. Add \$3.50 delivery, and \$6.54 or \$5.34 sales tax, respectively, in California. Credit card holders may call the toll free number below, or send check. Please mention this magazine.

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Popular Science

The **What's New** magazine

JULY 1981

Founded in 1872/Vol. 219, No. 1

MONTHLY®

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Tension structures make huge—and elegant—buildings

These colossal tents, designed by computer, are remarkably practical. PAGE 56

The great gasohol debate

It's a complicated issue—not just a question of bread versus fuel. PAGE 53

The challenge of ocean treasure: deep-sea mining

Manganese nodules litter the seabed, but gathering them is the problem. PAGE 64

Computer power—pro models at almost home-unit prices

You, too, may be ready for a desk-top business computer. PAGE 50

The hazards of buying haul-it-yourself concrete

You may pay for it, tow it home, and . . . have a useless mess. Be wary. PAGE 73

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EDITORIAL OFFICES 380 Madison Avenue, New York, N.Y. 10017

Published monthly by TIMES MIRROR MAGAZINES, INC., 380 Madison Avenue, New York, N.Y. 10017

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Published monthly by

TIMES MIRROR MAGAZINES, INC.,
380 Madison Avenue, New York, N.Y. 10017
A Times Mirror Company

ISSN 0161-7370

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PS READERS TALK BACK

Address letters for this column to: Readers Talk Back, Popular Science, 380 Madison Ave., New York, N.Y. 10017. Because of the large volume of mail, we are unable to acknowledge unpublished letters.

Gasohol controversy continues

The contention that grain used for alcohol production cannot be used for cattle feed is incorrect ["The Gasohol Controversy," PS/What's News, Feb.].

Starch is the only part of the grain required for alcohol production. The starch is converted to sugar from which alcohol is made. It is of little or no value in cattle feed.

The residue that remains after the starch is removed contains all the protein and food value of the original grain (protein is actually increased due to the yeast's action on the starch). This residue can still be used for cattle feed or to produce grain byproducts.

W. J. Parzygnat
Rochester, N.Y.

I must take exception to your editorial in the February issue. The result of increased use of grain alcohol as a fuel would be just the opposite of the predictions of the so-called grain experts.

Fact 1: The residue of producing alcohol from grain, known as DDG (distiller's dried grain), is a very nutritious stock feed.

Fact 2: Since the grain has already been used to produce a product salable at a profit, this residue can be sold to stockmen at less cost than can "new" grain, producing a second profit on the grain and at the same time lowering costs to stockmen and meat consumers.

Fact 3: As the supply of alcohol increases, the alcohol can be used to fuel the distillation, lowering the overall cost even more.

There is another benefit that no one even mentions. That is, the source of our fuel's raw material would be the American farmer, not the Arabs. All those billions of petro dollars would become billions of corn dollars, and would stay here to give our economy a shot in the arm such as no one has ever seen before.

Frederick H. Johnson
Lake Luzerne, N.Y.

Mr. Johnson's final point is certainly the major argument in favor of an alcohol-

fuels program. The other points raised by both Mr. Johnson and Mr. Parzygnat involve unexpectedly complex and inter-related issues. We assigned science writer Edward Edelson to look into the facts, suppositions, and crystal-ball gazing that add up to the gasohol controversy. We think you'll find his report, which appears in this issue, very enlightening.

Saturn's secret?

Could it be that the answer to the mystery of Saturn's rings [PS, March] can be found in quantum mechanics applied on a macroscopic scale? According to quantum laws, electrons can exist only in specific orbits. Perhaps in Saturn's rings there are certain zones where particles and objects are allowed to orbit, and other zones where they are not allowed. This might explain the existence of 1,000 or more ringlets and the gaps that separate them.

C. Dickson
San Diego, Calif.

Bryan Soltner replies: "Nice try. But quantum theory was invented to explain deviations from Newtonian mechanics in the atomic model. To turn around and apply it to the motion of heavenly bodies is an exercise in circular reasoning. Unlike electrons bound in an atom, which are allowed only specified energy levels, planets or moons bound in a gravitational system can theoretically possess any amount of energy."

Cat's meow

I noticed that in "What's New in Boating" [PS, March] you named the Super Cat the "fastest cat" at 22 miles per hour. Actually, it isn't. At the 1971 speed trials of the Pacific Multihull Assn., the Hobie 16 was clocked at 25.9 mph.

Bob Brown, Advertising Director
Hobie Cat, Oceanside, Calif.

I devoured Ben Kocivar's article "Multihull Speedsters" [PS, March], especially the part about the NF2 rubber-hulled cat-
Continued

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ACCORDING TO THOSE WHO KNOW PICKUPS BEST, VW IS THE YEAR'S BEST PICKUP.

The people at Pickup, Van & 4WD maga-

zine just chose

the VW diesel as their 1980 "Pickup of the Year."

Which is a great honor. But no great surprise. Because there

was no other pickup that could match up to it. And our 1981 is even better.

Take handling: Thanks to its precise rack-and-pinion steering and front-wheel drive, the VW Pickup actually handles more like a sportscar than a truck. (What's more, it has enough pickup to out-accelerate an MGB.)

Yet it still gives you a full six-foot-long bed that's big enough and tough enough to handle up to 1100 lbs. of solid payload.

In addition, no other truck in its class offers you the solidness of

double-wall construction and a fully unitized body.

And, perhaps most important of all, no other truck in America offers you better mileage.

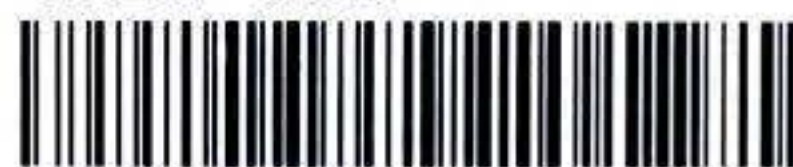
In fact, with its optional diesel engine and 5-speed transmission, the VW Pickup gets an estimated [38] mpg, 51 est. highway. (Use "estimated mpg" for comparison. Your mileage may vary with speed, weather and trip length. Actual highway mileage will probably be less.)

All of which has really made a hit with the people who know pickups best.

The ones who buy them.

VOLKSWAGEN DOES IT AGAIN

This One



BBF1-GD6-2XKU

PS readers talk back

[Continued]

amaran with hydrofoils added. As an avid sailor and owner of a Hobie 16, I wonder if it is possible to buy kits or plans for building such hydrofoils.

Douglas E. Kelly, Bellevue, Wash.

Ben Kocivar replies: "The Super Cat got its rating by the North American Multihull Assn. for handicapping in mixed-class racing. That is quite different from the speed-trial record, which is a one-way run under optimum wind conditions. In fact, there are 20 production cats that have higher handicap ratings than the Hobie 16, including the Hobie 18.

"To my knowledge there are no build-

ing plans currently available for foils for a Hobie. Detailed plans, instructions, and tips for 'flying' a foil-borne 'Flying Fish' with a 100-150-sq.-ft. sail are available from Donald Nigg, 7924 Fontana, Prairie Village, Kan. 66208. Price: \$30 (\$35 overseas) including postage."

Eschew obfuscation

Good news. We finally have tire ratings stamped and molded into every tire [PS, April]. But lest they be too easily understood, tire manufacturers use codes for each category. Would someone please explain why it is not practical to stamp

66,000 instead of 220? Why can't manufacturers just say in plain English what is meant?

Richard G. Steinbrueck, Dunedin, Fla.

The article states that traction and temperature resistance are scored with A, B, or C ratings. Then we are referred to an article in PS, April '80, to decipher what these letters mean. Please give those of us who have last year's issues boxed away in the basement a break. Which rating is best?

W. E. Welch, Chicago Heights, Ill.

Herb Shuldiner replies: "There's a good reason why the government doesn't want tire manufacturers to stamp actual mileage numbers, rather than a grading code, on their products. Actual tread-wear life depends on many factors, including road composition, driving habits, and tire inflation. The grading code reveals only relative tread-life expectancies compared with other tires.

"For traction and temperature resistance, an A rating is best."

Weakened Weekender?

The "Weekender Sloop" home-built boat design by Susanne and Peter Stevenson [PS, March] intrigued me. But before I send away for plans and start building, I have one question: Wouldn't the flat bottom of the boat tend to weaken the structure when waves from passing motor boats hit it broadside?

Steve Herrin, Cheyenne, Wyo.

Peter Stevenson replies: "The bottom of the Weekender is made from 1/2-inch plywood with an extra coating of fiberglass—so it's not exactly on the skimpy side for a boat of this length. The bottom panels are bent down onto the 2 1/4-inch-thick center keel and have 3/4-inch doublers at the mid-points of the chines. You are right: A flat-bottom boat will pound in a chop. But with this boat's light displacement and thick bottom panels, this is not a structural problem."

Acid test

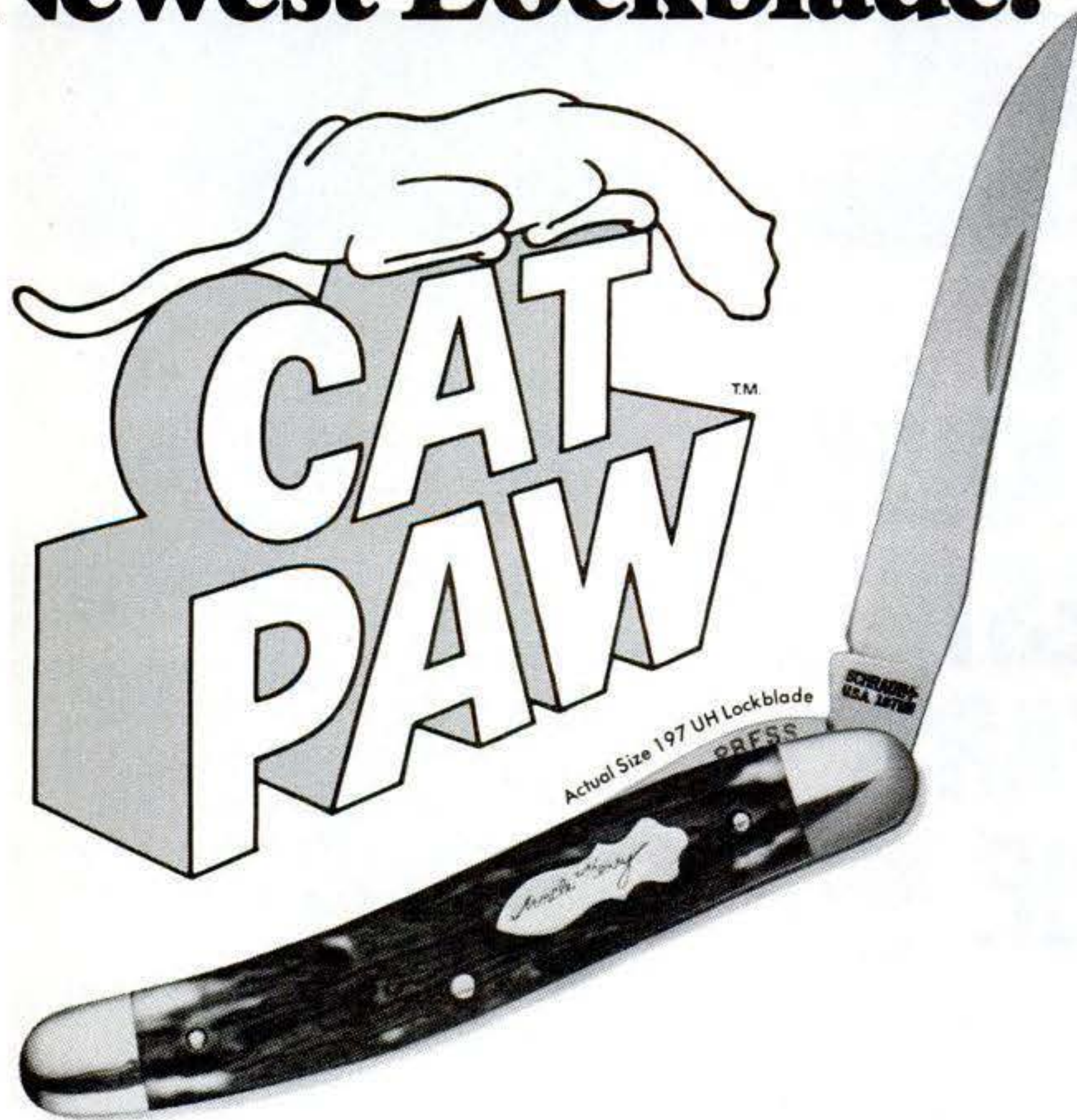
In Tom Johnson's story "Best Battery Yet?" [PS, April] he says that the aluminum-air cell shouldn't be called a battery because "it doesn't store an electric charge as does the six- or 12-volt battery under the hood of your car." Sorry, Tom, but a lead-acid battery doesn't store an electric charge either. It generates electric current when a load is placed across its terminals. The common reference to it as a storage battery is erroneous.

Ed Antal, Odenton, Md.

Corrections: The contract to develop an advanced lightweight torpedo for the U.S. Navy ["What's New," PS, April] was awarded to Honeywell, Inc. McDonnell Douglas Corp.'s prototype (pictured) will not be manufactured.

One of the tire manufacturers listed in the table with the article "Rating Radials" [PS, April] was misspelled. The correct spelling is Jetzon. E3

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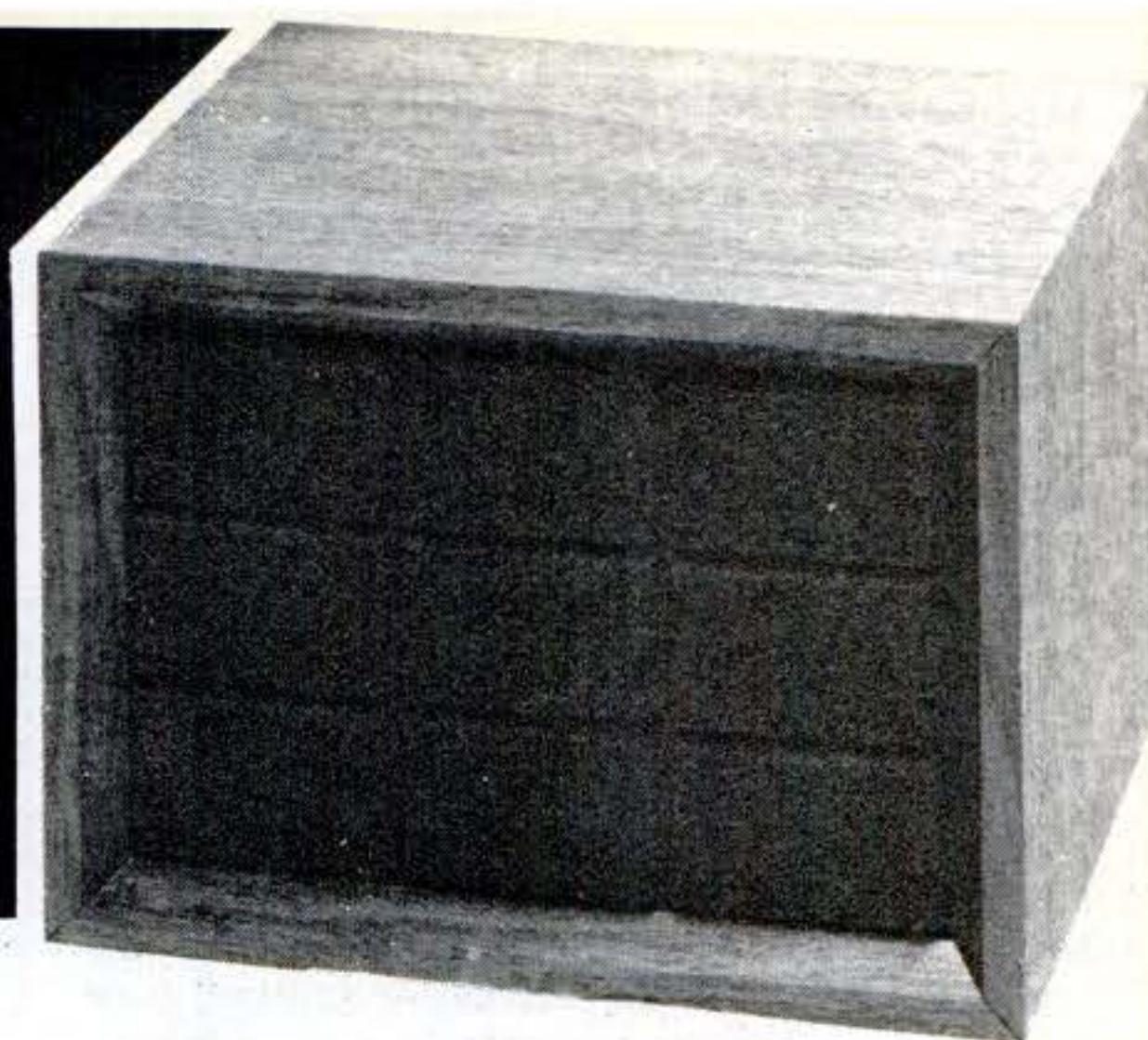
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When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected, (it can be only a second or two after the first break-in sound) the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.



The rear control panel contains two standard AC plug receptacles for a table lamp, spot lights, radio, etc., terminals for connecting optional outside siren and back-up battery (battery not included); entry delay time control and sensitivity control.

The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6 3/4" x 9 3/4" x 8") and weighs less than 6 1/2 pounds.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

WARRANTY

One year, 100% parts and labor when returned to factory post-paid. A five year extended warranty is available for a charge of \$25.00.

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The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from main alarm, they are available with 50 feet of wire for \$29.95. (Connecting terminals are provided on the back of the alarm).

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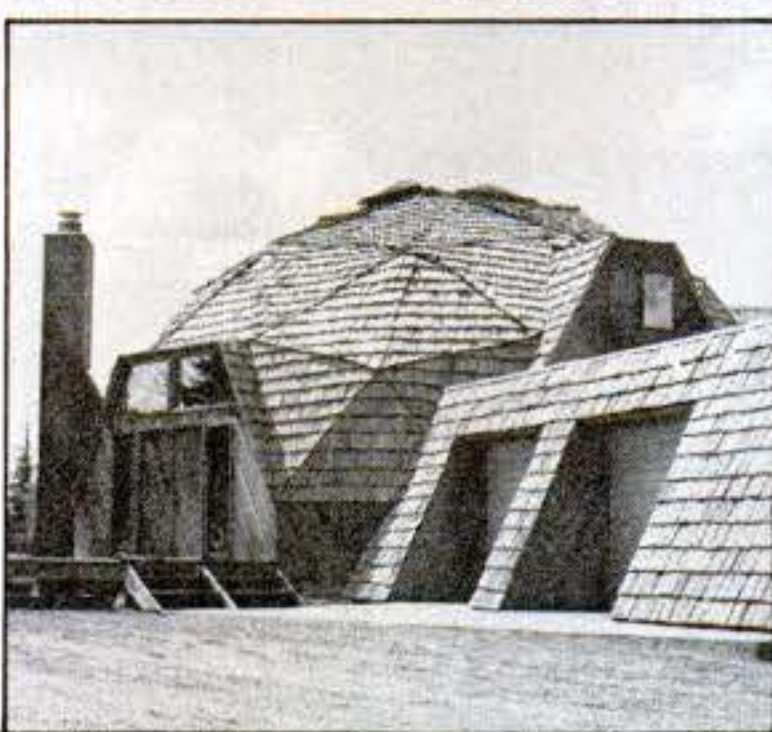
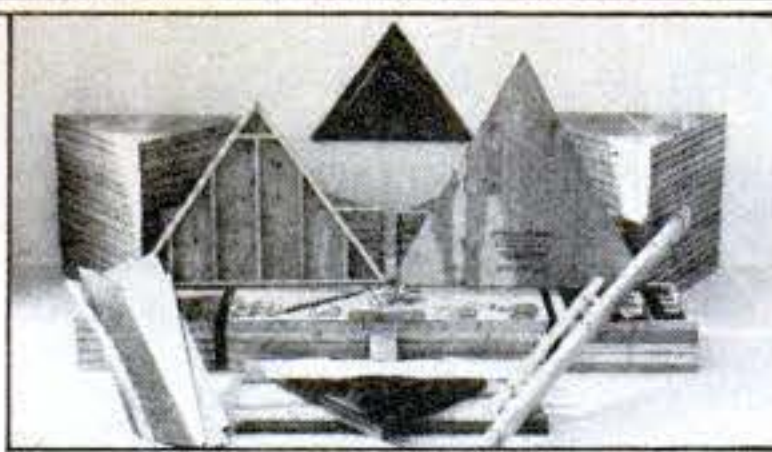
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Surgeons: Don't stitch — staple



Using forceps to bring the skin edges together, the surgeon simply squeezes stapler's handles to close the incision.

If it makes your skin crawl to imagine a surgeon bending over your abdomen and saying, "Stapler, please," you're probably not alone. But even though it sounds rather cold, skin stapling is less painful than stitches, and helps reduce scarring, too. With the recent introduction of disposable models, stapling may become a standard operating-room procedure.

Because the staples straddle the incision, they do not leave the "rail-road-track" scars that are caused by stitches, which dig into the skin. In most cases, the only scars left by the staples are minute pierce marks.

Staples are also less likely to cause infections. Because they are stainless steel, they do not react with the body's tissue the way sutures do.

From the surgeon's perspective, skin staplers offer the advantages of accuracy and, more importantly, speed. A closing that would take 30 minutes using sutures can be done in less than five with a stapler. This, of course, helps patients, too: It lessens the time under anesthesia and gets them off the costly operating table sooner.

Currently, 3M and U.S. Surgical Corp. are the major manufacturers.—
Marita Begley

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My name is Dr. George McCarty. I teach math at the University of California. I wrote this guidebook to cut through the confusion. It does just that — with worked-out examples, simple exercises and practical problems — all designed to work with precision and magic on your calculator!

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Important numerical techniques? Those algorithms are here, too-rational and Padé approximation, bracketing, continued fractions, Euler's method, Heun's method, iteration functions, Newton's method, predictor-corrector, successive substitutions, Simpson's method and synthetic division.

LOOK AT WHAT USERS SAY: Samuel C. McCluney, Jr., of Philadelphia writes:

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then approach the limit and stop."

Professor John A. Ball of Harvard College (author of the book *Algorithms for RPN Calculators*) writes: "I wish I had had as good a calculus course."

Professor H. I. Freedman of the U. of Alberta, writing in *Soc. Ind. Appl. Math. Review*, states: "There can be no question as to the usefulness of this book...lots of exercises...very clearly written and makes for easy reading."

C.B. of Santa Barbara says: "Your book has given me much instruction and pleasure. I do not hesitate to recommend it. **'CALCULATOR CALCULUS'** is a book that inspires the reader to understand everything down to the last detail. You seem to have put your heart into the teaching."

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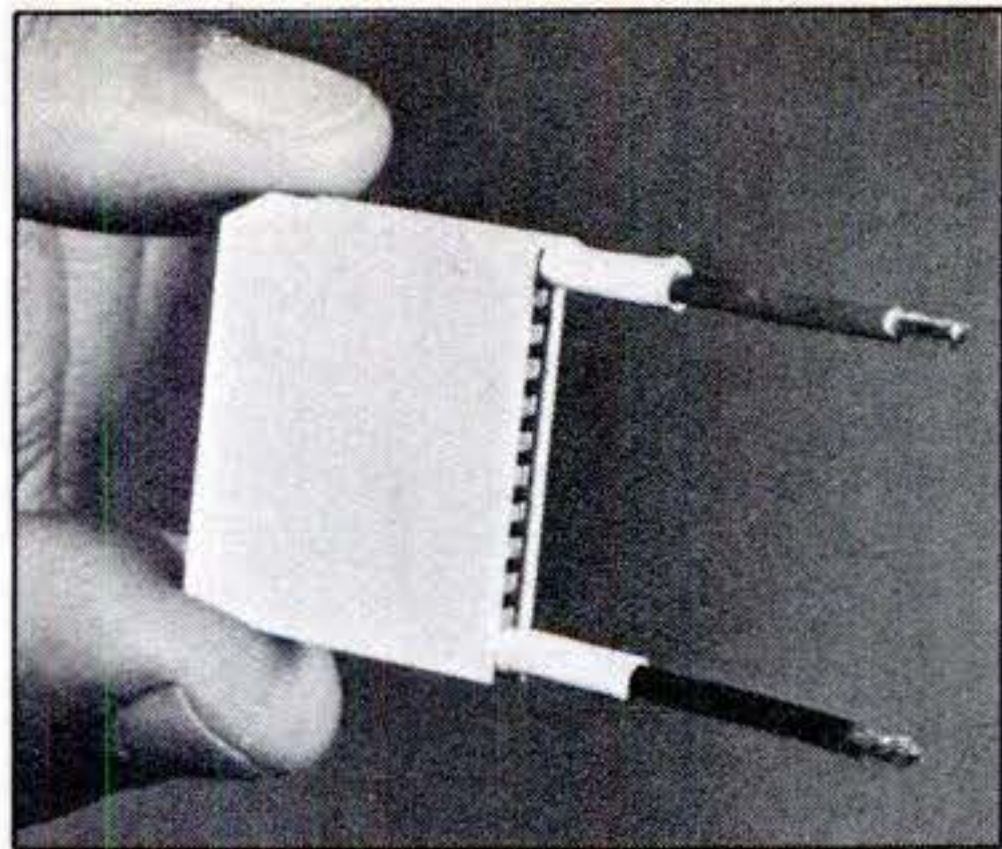
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The miracle of solid state refrigeration

Recreational refrigeration technology has leapt forward 100 years... and will never be the same again. In this explosive age of computers and integrated circuits... solid state technology has proudly given birth to a family of powerful lightweight recreational refrigerators. And in our great outdoors, tens of thousands of solid state portables are efficiently eliminating the ice-age. The harassed cooler owner, formerly left to the mercy of the remote and empty ice vending machine, has finally been liberated.

THE PELTIER MIRACLE CHIP

Jean Peltier noted the phenomena back in 1834. His experiments resulted in a new law of physics. He observed that by passing current through the junction of two dissimilar metals, heat began to flow away from the junction. Over the years, using rare and exotic metals, powerful Peltier devices have been created. Incredibly enough, a module no bigger than your watch now produces more cooling power than a 10 lb. block of ice. However, because of cost, the miracle chip has served only the scientific and aerospace fields... until now.

KOOLATRON BREAKS THROUGH THE COST BARRIER

Here was the challenge. The technology was expensive. Yet a high quality electronic refrigerator had to be designed at an affordable price. Koolatron engineers responded by encasing the costly Peltier modules in a tough "cooler-like" chest. Using quality materials and the best insulation available, a handsome, rugged, light-weight portable was achieved. Next, a control system was needed to tell the miracle chip what to do and when. Through sophisticated circuit design, a small electronic "brain" was created. The job was done.

Now when you plug your portable into your vehicle's cigarette lighter, millions of electrons flow through the module... extracting heat from the interior... electronically refrigerating your food. Automatically, your battery voltage is measured. If recharging is required, a warning light starts to blink. Sensors measure the temperature you have selected. The circuit cycles power off and on to maintain that temperature. And if you choose to engage a

switch marked "hot", the process is reversed. Suddenly, as if by magic, your portable fridge is converted into an ingenious food warmer. But Koolatron's greatest achievement was to squeeze all this technology into a price tag of less than \$200.00.

SIMPLICITY... WITH A WORLD OF USES

Each of this family of portables has unique features. But all of them operate with basic simplicity. Using a supplied power cord, you just plug into your cigarette lighter or into house current with the optional 110 volt adaptor and select the temperature you desire. It is just that simple. Yet the multitude of uses is endless. In summer or in winter, whether you travel once a year or revel in the out-of-doors, you'll be over-whelmed with the convenience, savings and versatility. Say good-bye to your ice chest. The new world of electronic refrigeration is at your doorstep, awaiting your command. To go with you on your vacations or to your cottage. To refrigerate foods, beverages, dietetic food or even baby's formula. To serve you in your car, recreational vehicle, boat, plane or beside your pool. To refrigerate dependably on your hunting, fishing, camping and boating trips or in your motel room. And in winter, at the flick of a switch, your P10 or P34A will be your loyal servant, serving you hot foods during your skiing, snowmobiling and ice-fishing week-ends. But if winter finds you indoors, your portable will quietly perform as an office fridge, bar fridge, wine fridge... with the aid of your optional 110 volt adaptor.

WHICH ONE COULD SERVE YOU BEST?

The Koolatron Model P10 is the perfect personal fridge. It refrigerates 17-12 oz. pop cans or 15 lbs of food in air temperatures up to 95°F. Hot foods will stay hot at the flick of a switch. Measuring 16" long, 11" high and 11½" wide, it has 11 qts. of capacity within its rich blue polypropylene case. Weighing only 10 lbs. empty... the P10 is the perfect size and weight for a personal car fridge and food warmer.

The P34 is the ideal recreational fridge. It holds over 40 lbs. of food or 48 beverage cans and refrigerates in air temperatures up to 95°F. Rugged ABS casing in sand beige colour with dark brown non-corroding latches and handle. Large 36 quart capacity (1.2 cu. ft.)

it weighs only 17 lbs. empty. External dimensions are 21" long x 16" high x 16" wide. The P34 is a refrigerator only, with fixed temperature controls, providing family size capacity whenever it is needed.

The P34A is our top of the line recreational refrigerator and food warmer. It is the same size, colour, weight and capacity as the P34 but includes food warming, fully adjustable temperature control and low battery warning indicator. For capacity, versatility and performance... there is nothing better at any price.

21-DAY MONEY-BACK GUARANTEE

Koolatron Industries is the largest manufacturer of solid state recreational refrigeration in the world. This is a direct result of our efforts to provide the highest possible quality and service at the lowest possible price. We guarantee that if you try any of our portables for 21 days... and are less than satisfied, we will promptly refund your money. Your portable is backed by a written one year warranty and major service centers in New York, Arizona and Canada. So order today with complete confidence. Join the tens of thousands who already have.

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____ Koolatron P34 at \$179.00 (\$189.00 in Canada)

____ Koolatron P34A at \$199.00 (\$209.00 in Canada)

____ Koolatron 110V adaptor at \$39.95 (same in Canada)

Please add \$9.00 for handling and delivery per unit.

No charge for shipping adaptor if ordered with unit.

Add \$3.00 for shipping adaptor by itself.
(N.Y., Ont. and Quebec residents add sales tax).

I understand that I may return any item undamaged within 21 days and receive a full refund if I am not satisfied.

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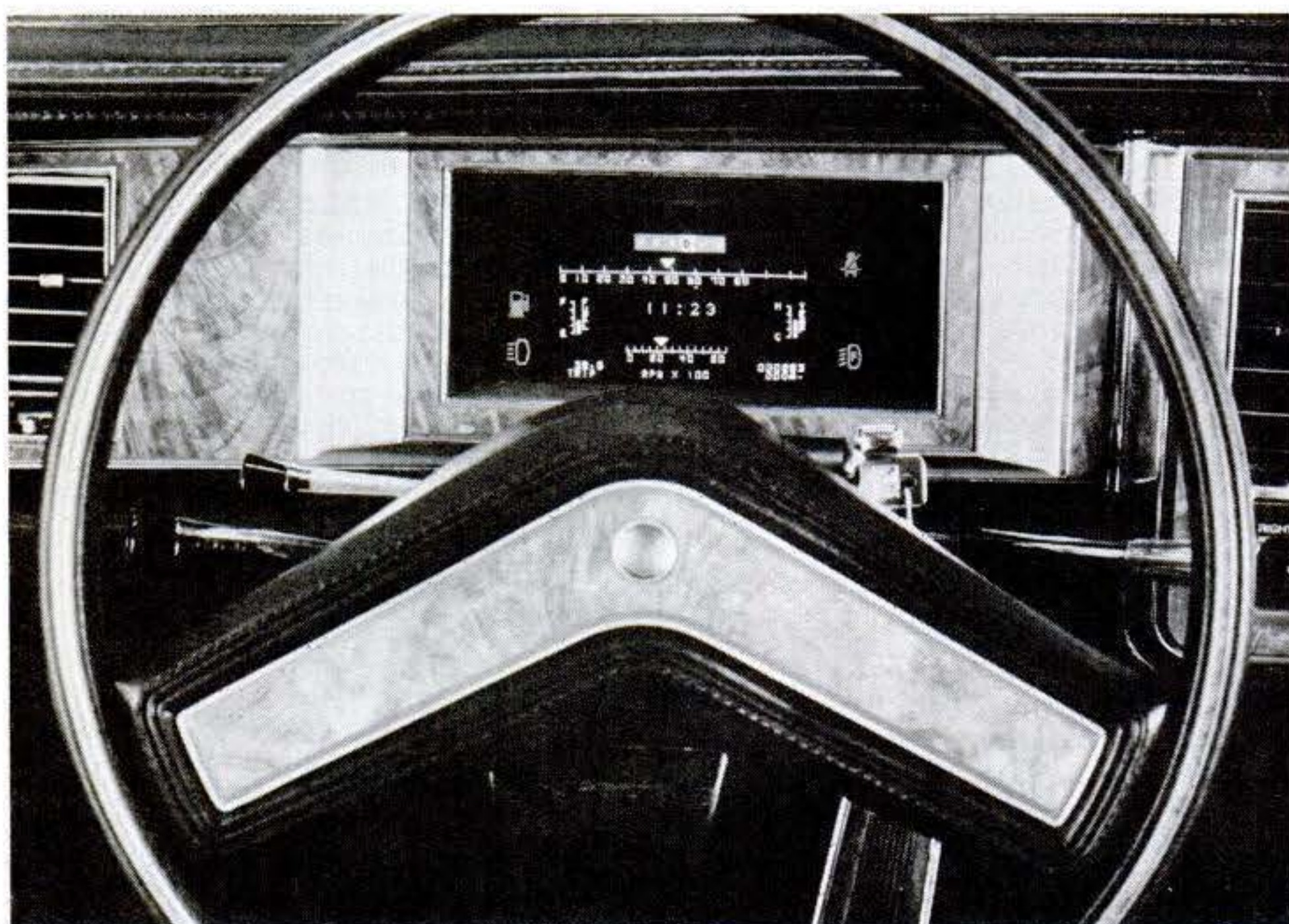
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Dashboard CRT

— on-the-road info at a glance



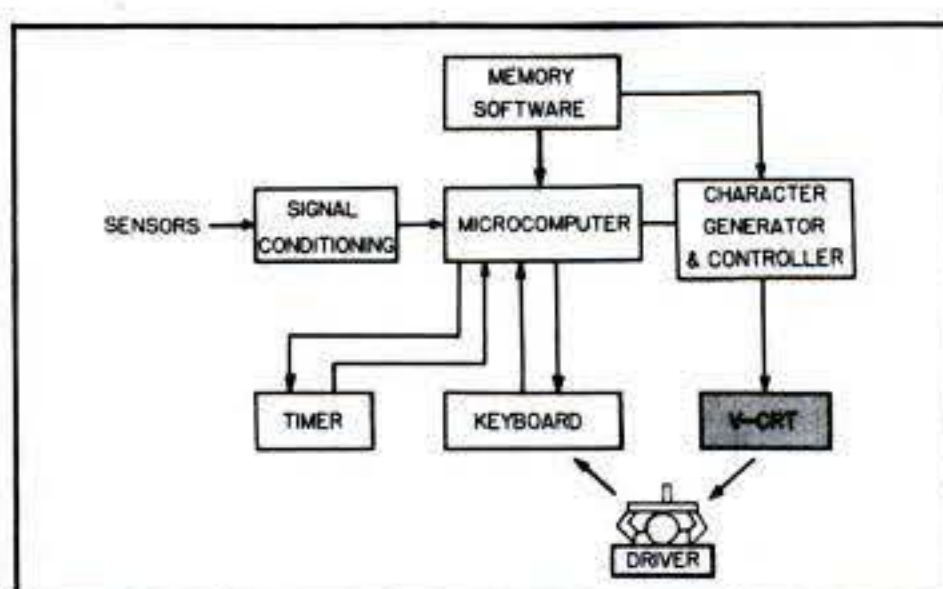
Zenith's V-CRT can show standard dash information (top) or instantly flash an important message to you (above). It is

Color TV screen in your car displays numbers, words—even pictures

By WILLIAM J. HAWKINS

You're lost. No road signs, no gas stations, no help—but no problem. Push a button.

The dashboard display in front of you goes dark briefly. Numbers that once showed your speed, rpm, and engine temperature suddenly disap-



controlled by the car's computer system; to change the display, the computer is reprogrammed by changing the chip.

pear—to be instantly replaced by a full-color road map pinpointing your exact location. Moments later, the display returns to normal.

That's the idea behind Zenith's V-CRT dashboard display. It's part of an on-board information system that's totally flexible. It can show numbers or letters, flash warning messages, display pictures and graphics, or simulate a conventional dashboard display. The V-CRT (vehicular cathode-ray tube) is a picture tube—like the one in a TV—designed for auto use.

Unlike a mechanical or digital display, a CRT can show anything and in any format. It converts an electronic signal into a picture—changing the display means merely changing the signal. That, of course, is hardly news to anyone who's seen a television set. The difference is that the V-CRT overcomes some major problems for auto use: brightness, X-ray exposure, sharpness, physical size, and the possibility of implosion.

Sunlight, for example, can wash out a TV image. To prevent it, the V-CRT uses special screen phosphors and operates at a much higher electron-beam current. Result: The display is 10 times brighter than that of a conventional TV tube.

The electron gun (which scans the screen to create the image) is designed to handle the larger current flow while still producing a small spot size for sharpness. And its beam can scan a full 110 degrees, allowing the gun to be moved up closer to the tube face. That keeps the overall depth of the tube to 7.7 inches, easily fitting into a standard dashboard.

The glass bulb used for the tube can absorb far more energy in the form of X-rays than is produced by the CRT itself. The result, according to Zenith's vice-president for research and development, Len Dietch, is that the V-CRT actually shields the car's occupants from some of the normal X-ray background radiation they would otherwise be exposed to from the environment.

The glass bulb is protected by additional outside packaging: If implosion should occur (in an accident, for example), no glass from the bulb will enter the passenger compartment.

The V-CRT is intended for mid-'80's automobiles. (All Zenith has to do is sell Detroit on the idea.) Connected to existing or new microprocessor auto circuits and sensors, the display could show everything from fuel consumption to estimated time of arrival—with, perhaps, brief interruptions to remind you of an oil change coming up.

Color graphics could mean instant pictures of stored information—maps, travel guides, even a pictorial drawing of your car chassis for servicing.

The exact displays it will show depend on the computer's program. To provide updated and varied displays for new or different car models will simply entail a different set of programming instructions—easily done merely by replacing an integrated circuit chip. By contrast, factory retooling is now required just to change the placement of a dash light bulb in a new-model car.

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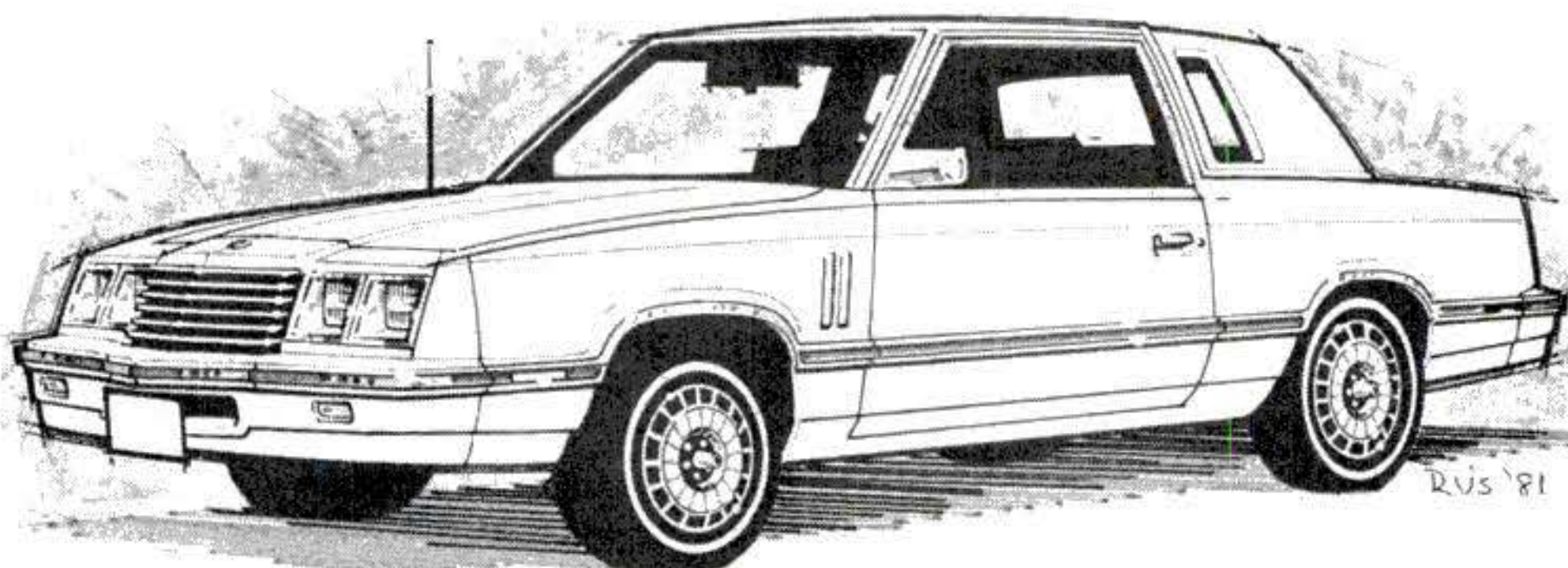


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DETROIT REPORT

By JIM DUNNE



It's Super K

Chrysler's big news for 1982 will be the introduction of a pair of luxury coupes using the K-body chassis (above). The Super K's, to be sold under new names in the Dodge and Chrysler lineups, will offer the same front-drive systems as Reliant/Aries but will carry premium price tags—a couple of thousand dollars higher than the K's. Other differences will include minor improvements in the chassis, front suspension, engine accessories, and hood-opening convenience. At first, only two-door models will be produced; later in the year, station wagons and four-door sedans will be added.

Loyal to mechanics

Car owners want to talk to their mechanics directly and are dissatisfied when their complaints are told only to a write-up man. That's one conclusion of a three-year study of consumer auto-repair attitudes prepared for the National Highway Traffic Safety Administration. Car owners, who spend an estimated \$20 billion each year on repairs, search out quality service and, finding it, tend to be highly loyal customers. The study found that service sta-

tions and independent garages are preferred over new-car dealerships because customers want direct contact with the person performing the repairs. Cost of repairs and number of certified mechanics are also important factors.

Diesel all the way to the bank

It costs 44 percent less to operate a diesel than a gasoline engine, according to a Dept. of Energy study. Diesel engines average 30 percent better fuel economy than gasoline types, and the fuel costs less at the pump. Overall, costs per mile for fuel are 3.89 cents for diesel engines, 6.89 cents for gasoline models. Over the lifetime of a car, fuel savings are reckoned at \$3,000, assuming that the price differential continues.

Favorites to bite dust

When Chrysler switches completely to four-cylinder engines in 1983, two of America's most successful power plants—the 225 Slant Six and the 318 V8—will go out of production. The Slant Six, a mainstay of the Chrysler lineup for more than 20 years, was used in a variety of Chrysler products, including the original Valiants

and Darts. Its durability and dependability helped make those compacts the most successful the company ever built. The 318, smallest of Chrysler's V8's, embodies all of the performance and durability features that Chrysler engineering is justly noted for. If the troubled auto maker is as successful with the 2.2-liter four now in the K-cars and the 1.8-liter four slated for Horizon/Omni in a couple of years, a big part of its future will be assured.

Planned obsolescence

Cadillac's 250-cu.-in. lightweight V8 that will be standard in 1982 models is slated for phase-out even before it gets into production. The 250, which replaces the innovative 368-cu.-in. V8-6-4 this year, will go by the board itself when the division converts to a V6 for the 1983½ model year. It's a sign of Detroit's adaptability to the new economic realities; in the past, new engines had expected lifetimes of at least 20 years. Still, the 250 investment is not a major loss for Cadillac. The V6 is designed to be built on the same machines—with some modifications—that turn out the V8, a forethought that will save the company the \$100 million cost of a new engine line.

Leftovers

The famous MG sports car went out of production last fall, but if you're lucky you might still find a new model left over in a showroom in this country. Jaguar Rover Triumph reports that a supply of models was on hand earlier this year. Parts will remain available for another 10 years, the company says.

The future is electric

General Motors estimates that it will be selling 200,000 electric cars a year by 1990 and that after that electrics will continue to grow gradually in number. GM bases its electric planning on the fact that coal-fired power plants can produce electricity for hundreds of years, while petroleum fuel is running out. Looking far into the future, GM also believes that there will be a limitless supply of electricity from nuclear-fusion plants beginning in the third decade of the next century. The auto giant hopes to have its first battery-powered commuter car on sale in 1985.

Bendix bucks trend

While turbochargers are getting increasing use as engine-power boosters, Bendix Corp. is betting that *supercharging* is the way to go for small engines of the future. Turbochargers use the wasted power of the exhaust stream to pack more air-fuel into the engine, while superchargers are driven directly by the engine through a chain connection. Bendix claims that the lag in turbocharger boost at low speeds is an Achilles heel. The supercharger delivers power during low-speed acceleration, when it's most needed, the company says. Bendix considers the supercharger's constant three-to-four-hp drag on engine power to be less of a handicap. **E**

Good news for jackrabbits

Sudden starts waste gas, right? Wrong, according to a BMW study, which shows that three-quarter-throttle acceleration is more efficient than a slow, gradual speedup. Reason: Your engine runs more efficiently at a heavy throttle position, and makes the most of the gas it burns. At about 2,000 rpm, you should shift gears and accelerate the same way, getting into high gear as quickly as possible. (You can accomplish the same thing with an automatic-transmission car by accelerating quickly, then letting up on the pedal to allow the transmission to shift.) Then

let your engine loaf along at a steady speed near the 2,000-rpm level.

The problem with slow acceleration is twofold: At slow speeds, the engine is doing little more than idling; and it must run longer to get from point A to point B.

This advice runs counter to the readings you get from those computerized mpg meters, which will indicate poor fuel economy during fast acceleration ["Mpg Meter," Aug. '80]. The reason for this is that most meters measure engine vacuum level, not fuel consumption. Their readings are accurate at cruising speeds but can be misleading during acceleration from a stop.

ALTERNATE-ENERGY ANSWERS

By JAN F. KREIDER

Jan F. Kreider is a consulting engineer specializing in the design and economic analysis of solar-energy and energy-conservation systems. He is the author of several books on solar technology, and a lecturer at the University of Colorado.

Sources of steam engines

Following up on "Steam Power" in the January column, readers Allen C. Messer Jr., Brinton E. Jefferies, and others have provided some current sources of steam engines (most catalogs cost a few dollars): Semple Engine Co., Box 6805, St. Louis, Mo. 63144; Steam Power Products, RR 2, Koshkonong, Mo. 65692; Tiny Power, Box G, Tehachapi, Calif. 93561; Scripps Foundry, Box 188, Balmorhea, Tex. 79718.

Live Steam Magazine (Box 629, Traverse City, Mich. 49684) is published monthly for steam aficionados.

Reader Messer modified a Freon compressor [PS, Oct. '55] into a steam engine.

Quicky collector

How practical would it be to put glazing directly over a metal roof to form a solar collector?

Glenn Buchter, Lebanon, Pa.

This has been done in the past with good results. However, please consider the warnings about overheating wood (below the metal roof) and the possible fire hazard. If the collector is to operate efficiently, you need insulation beneath the roof, leak-proof air ducts or water-pipe connections, and a black surface on the roof. Of course, some method of supporting the glass under heavy snow or wind loads is also needed. If the roof is large, it may be difficult in the future to replace a broken glass cover in the center of the array.

DHW from a boiler

PS often mentions that oil burners are about 75-percent efficient. But what about the efficiency of heating domestic hot water (DHW) in an oil-fired, residential boiler? I have heard that summertime efficiency can be 15 to 25 percent.

Michael Hill, Fulton, Md.

DHW heating in a coil-less heater or other boiler designed for space heating is very wasteful. This is an archaic design with no place in the current energy-scarce U.S. economy. The efficiencies you quote seem low but may be about right depending on the design and age of the system. Standby losses are very large with these systems.

Low-temperature turbine

I am of the opinion (perhaps mistaken) that someone could develop a low-temperature steam turbine for generating electricity powered by solar collectors.

Has any work been done in this area?

Bob Van Halder, Salem, Ore.

Low-temperature solar turbines have been built by Barber-Nichols Engineering (Denver, Colo.) and AiResearch (Torrance, Calif.). However, most have been very expensive prototypes. Because of thermodynamic constraints, residential-size turbines using Freon have very high rotational speeds—above 50,000 rpm. Care in fabrication is essential.

[Ormat Turbine (Box 68, Yavne, Israel), a research and development firm, built an organic-fluid, Rankine-cycle turbogenerator to run off flat-plate solar collectors and generate power for well pumping, but few were produced. That turbine has been revamped into much larger versions to draw on the thermal power of solar ponds (see "Solar Ponds," PS, April), with an eventual capacity of between five and 50 MW. Smaller turbines of this type are being used for industrial waste-heat recovery.—Ed.]

Nighttime shut-off?

As a possible energy-saving technique, I want to install a timer to shut off the power to my hot-water heater during non-use hours (10 p.m. to six a.m.). However, I'm concerned that it may take more energy to reheat the water in the morning than to maintain a constant water temperature throughout the day and night.

Michael Lanza, Wall Township, N.J.

When the power is off, the tank cools slowly. As it cools, the rate of heat loss also drops since the heat-loss rate depends on the difference between water and surrounding room temperatures. Therefore, you lose less than if the tank were on all night. However, you should check with your utility to see if you have a demand rate. This rate penalizes you for operating many appliances at the same time; or, in some cases, rates are higher in morning and early evening hours. The demand charge might cost you more than keeping the heater on all night. (To see how you can save money on hot-water heating see "Water Heaters," PS, Feb. '78 and "Flue-pipe Water Heater," PS, March '79.)

Vertical vs. tilted collectors

It has been our experience that although a vertical solar collector will collect 15 to 20 percent less sunlight than the same collector mounted angularly, the 15- to 20-percent loss is normally negated through reflection of sunlight off snow cover in northern climates.

Donald Roberson, New Richland, Minn.

I have made some calculations of winter solar radiation on vertical vs. tilted (at latitude +15 degrees) surfaces—both with clean snow to the south. The calculation method is given in The Solar Heating Design Process, to be published soon by McGraw-Hill. The table below shows that tilted collectors intersect more sunlight than do vertical ones in a month with more sun, such as March. In November, with less sun, there is little difference. Remember that tilted collectors also "see" the snow to the south of the collector. Other factors also determine useful energy delivery of the system, including outdoor temperature and solar angles. Performance of vertical systems is typically 15 percent lower over the year, but—as I noted in an earlier answer [PS, Nov. '80]—lower mounting costs may more than offset that performance.

Solar radiation (Btu/day-sq.ft.) gain by two collectors

City	November		March	
	Tilted	Vertical	Tilted	Vertical
Minneapolis	957	946	1,518	1,366
Denver	1,758	1,738	2,050	1,787
Boston	907	892	1,311	1,170
Kansas City	1,356	1,336	1,529	1,338

Unit confusion

In Europe we have difficulty converting the units for insulation that you frequently use—the R-value—into more familiar SI units. Can you give us a conversion from Btu/hr.-sq.-ft.-deg. F to kcal/m²-h-deg. C?

Walter Steemans, Deurne, Belgium

The English units for R-value are hr.-ft.²-deg. F/Btu. One of these units is equal to 0.176 m²-deg. C/W or 0.049 m²-deg. C/kJ. Since 1 kcal is equal to 4.19 kJ, the SI equivalent of R-1 is 0.205 m²-h-deg. C/kcal. For example, an R-19 wall has an R-value in your units of 3.9 (19 × 0.205).

Wood in solar collectors

The new solar specification from UL limits the use of wood to collectors operating below 194 degrees F. In our November 1980 issue we suggested 250 degrees F as the maximum. Any solar collector of moderate efficiency will be hotter than 194 degrees F on a sunny fall or spring day under no-flow conditions. The ignition point of wood is lowered over the years with prolonged solar exposure. [5]

Got a question on an alternate energy such as solar, wind, water, or wood? Wondering about energy-conservation techniques for home heating or cooling? Every other month, alternating with "Adventures in Alternate Energy," Jan Kreider answers selected questions from readers. Send yours to "Energy Questions," POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. Individual queries can't be answered by mail.

In the "Alternate-Energy Adventure" we present a project developed or reported on by PS readers, and pay \$200. Submit black-and-white glossies and a sketch to "Energy Adventure" at the address above.

Precision spotlight

Rotate the bottom of the Logotech spotlight against its angled base, and its beam shifts from straight down to horizontal. Since both the body of the fixture and the base are calibrated, it's easy to adjust the lamp to the exact angle you want. If you've ever tried to align a series of spotlights on a painting or to coordinate room lights, you can appreciate what a frustration saver this quick-setup feature can be.

The spotlight body is a unique elliptical cylinder. It's cut at less than a 45-degree angle, and the resulting cross section is a circle, matching the shape of the fixed base. Rotating the two parts against one another is akin to adding or subtracting their combined angles. In addition to the flexibility of the vertical angle, the entire unit rotates 360 degrees on its base.

Designed by Emilio Ambasz and Giancarlo Piretti of The Design Center in New York City, the spotlight system won a 1980 Design Excellence



Award from the Industrial Designers of America. It's distributed in the U.S. by Omega Lighting, 270 Long Island Expressway, Melville, N.Y. 11747.

The spotlight fixture is sold in two sizes and accepts most common bulbs.

It has its own complete line of reflector shapes and other spotlight accessories. The spotlight is manufactured in Germany by Erco, and will only fit on track systems made by that company.—Paul Bolon

You can tell this power company where to go.



To the campsite, worksite, cabin or beach. Aboard a boat, on a camper, in a pickup or trailer. Anywhere you've got the need, Kawasaki can give you the power. Dependable, quiet, economical power, from the easy-toting KG550.

This 36.6-pound lightweight is small in price, yet big on features. Circuit-breaker protection means there's no fuses to replace. And individual AC & DC outlets allow you to charge your car battery and run other electrical needs simultaneously.

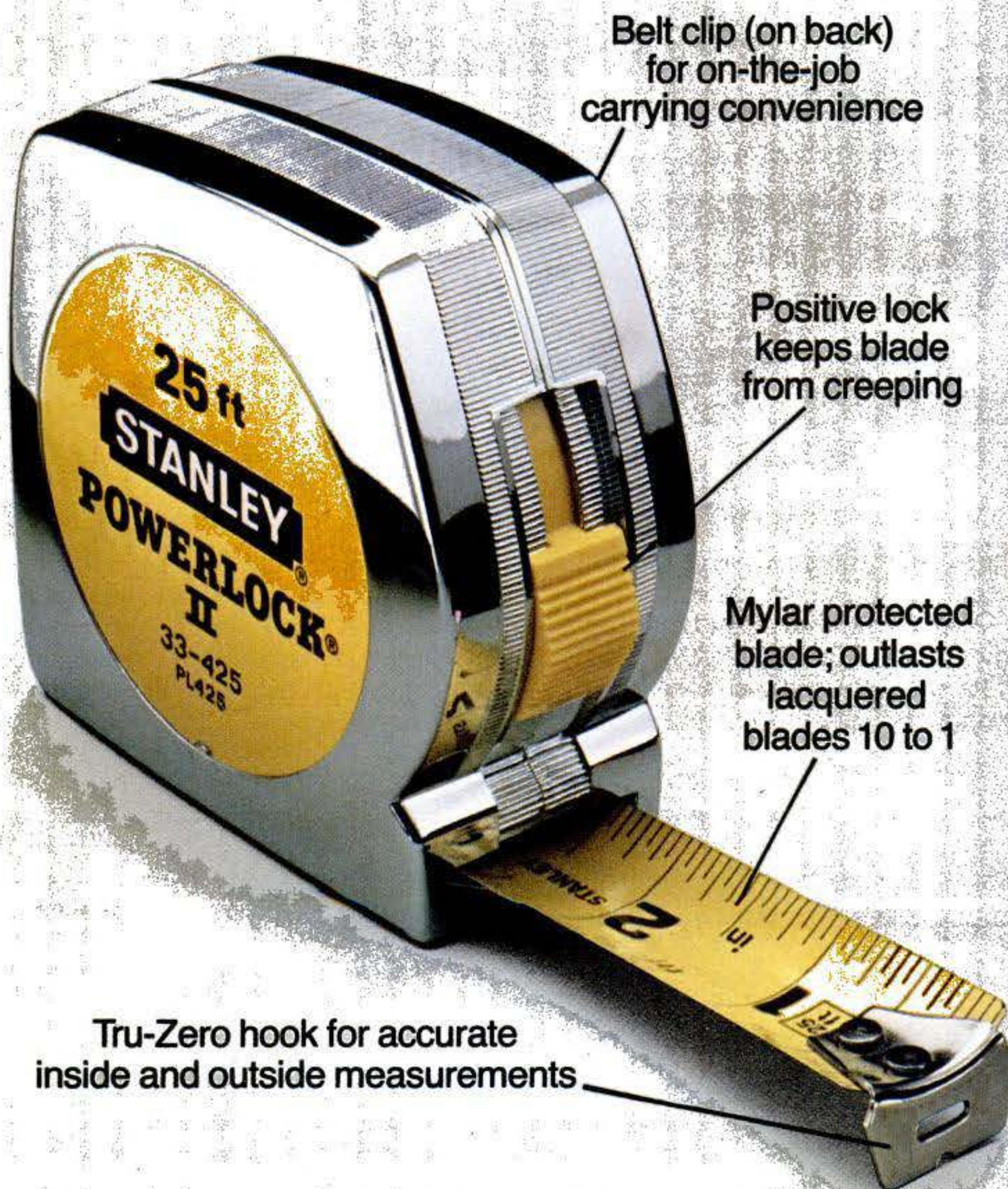
Ask your local Kawasaki dealer about the KG550 or one of the other Kawasaki Portable Generators. He's listed in the Yellow Pages.

Kawasaki

Portable Generators

From 500 to 2900 watts.

BUILD BY THE STANLEY RULE.



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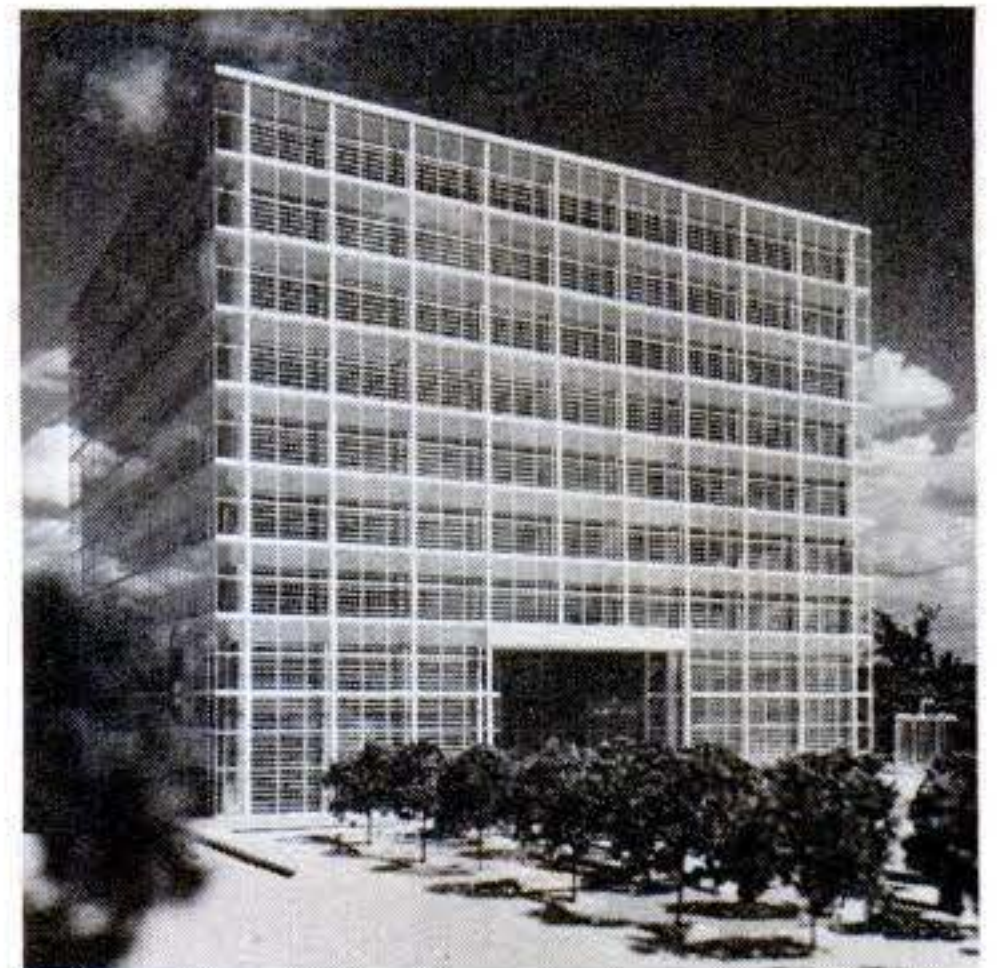
The #1 rule of Super Doers is "do it right." And that means using Stanley's #1 selling Powerlock® rules. Lengths from 6 to 25 feet; blade widths of 1/2", 3/4" and our extra wide 1" blades that stay rigid up to 7 feet. Measure up to any project, with Stanley. The tools used by America's Super Doers.



STANLEY helps you do things right.®

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Glass-walled building saves energy and view



Like giant sets of Venetian blinds, rows of airfoil-shape white louvers hang between the double glass walls.

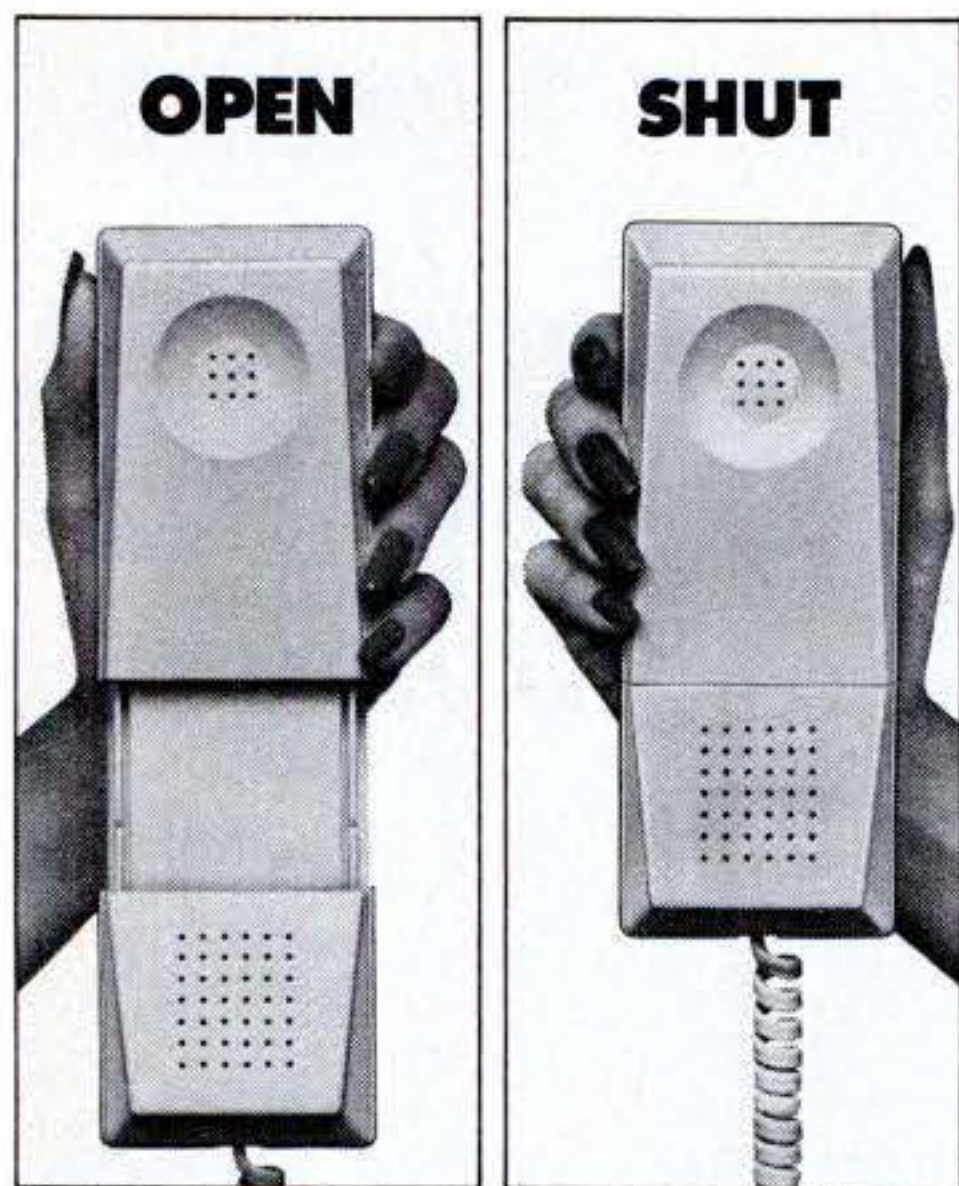
As the sun rises over Niagara Falls, the first rays of light strike sensors on the east side of a nearby corporate office building belonging to Hooker Chemical Company. The sensors signal a central computer, and motorized rods begin to drive rows of louvers open.

Air in the four-foot space between the building's double glass walls heats up in the sunlight and moves by convection to shaded areas on the other side. The computer, meanwhile, monitors temperatures on the floors and opens vents to provide heat when and where it's needed. If too much heat builds up in the walls, another set of sensors alerts the computer, and venting dampers are opened at the top of the cavity. At night the louvers close completely, and the building retains heat.

The louvers, however, were earmarked for more than one purpose by the architect, Cannon Design Inc.: They provide interior lighting, which, like the solar heat, is gratis. Daylight conditions prevail in a 15-20-foot zone close to the glass walls. Artificial lights supplement the daylight here and provide most of the lighting for the center of the building. These lights, like the vents, fire alarm, intercom, and security system, are controlled by the computer.

The building is scheduled for completion this fall. Designers say the total energy saving will be just over 50 percent compared with "energy-efficient" buildings located in similarly cold, but much less scenic, climes.—
Marita Begley

An open and shut case for owning your own phone.



You may not realize it, but you pay the phone company a monthly rental charge for every phone you have in your house. And those monthly telephone rental charges keep going up!

One way to beat the system is to buy an ITT Ultra 80™ phone at your favorite retail

store. With an ITT Ultra 80™ you only pay once and the phone belongs to you. So you never have to pay those monthly rental charges again! The savings can be substantial.

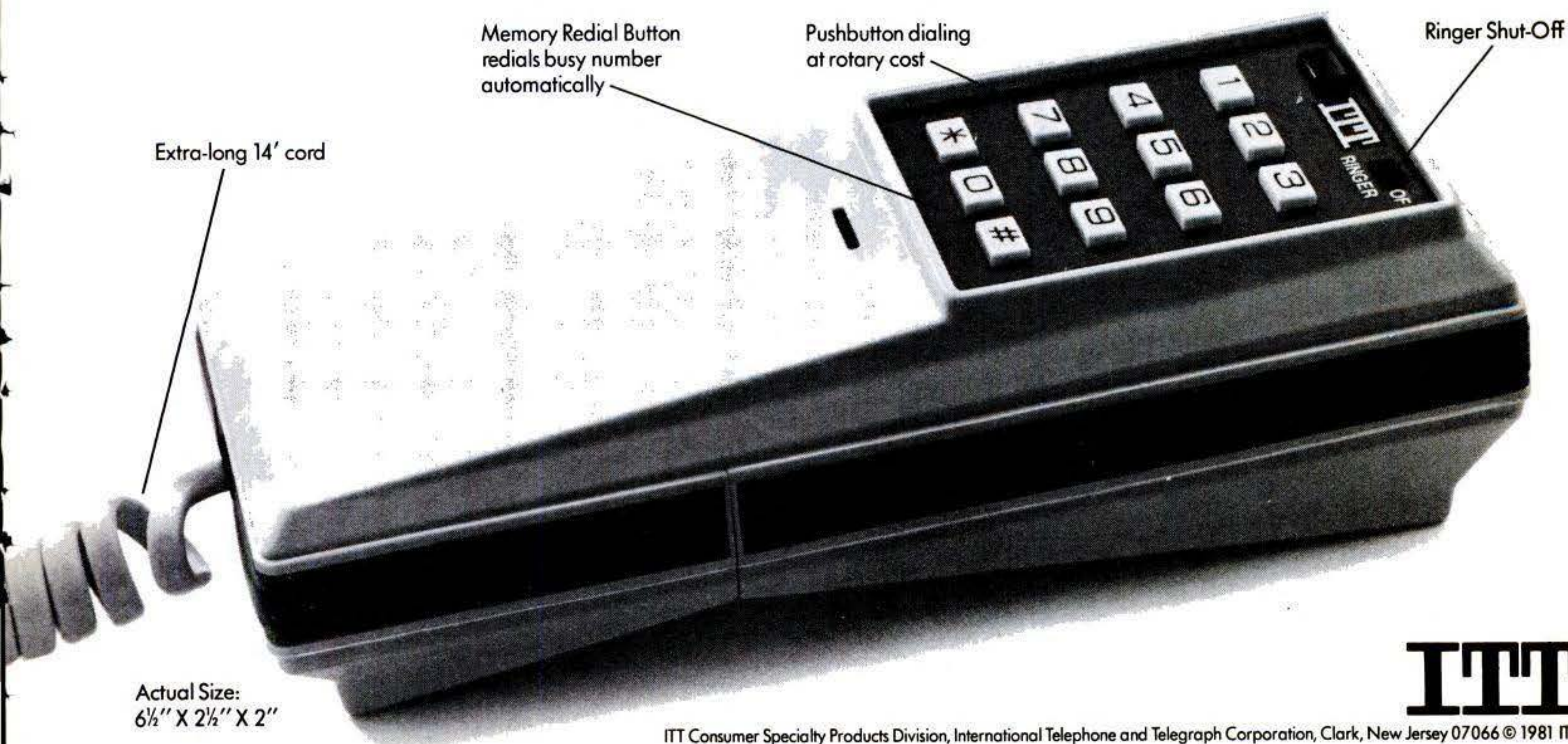
You can't get a phone like the ITT Ultra 80™ from the phone company, either. You just slide it open to use... close to hang up! And the Ultra 80™ features push-button dialing that works on both rotary or tone systems. A Memory Redial Button that redials a busy number at the touch of a button. A Ringer Shut-Off Switch that turns off the ringer when you don't want to be disturbed. Plus a button that gets you a dial-tone without hanging up.

You'll like the way the

Ultra 80™ works...and everyone who sees it in your home will like the way it looks. It comes in two popular designer colors—almond beige and cocoa brown, each with accent trim. It's a little decorator touch that can mean so much! There's even an optional wall holder for your kitchen or den. And the Ultra 80™ is a snap to install. Just plug it in. That's all there is to it.

The ITT Ultra 80™ is just one of dozens of quality ITT Own-A-Phone® telephones available at retail stores everywhere. For the store nearest you, just call this toll-free number: (800) 526-4262.

ITT Ultra 80™ Telephone



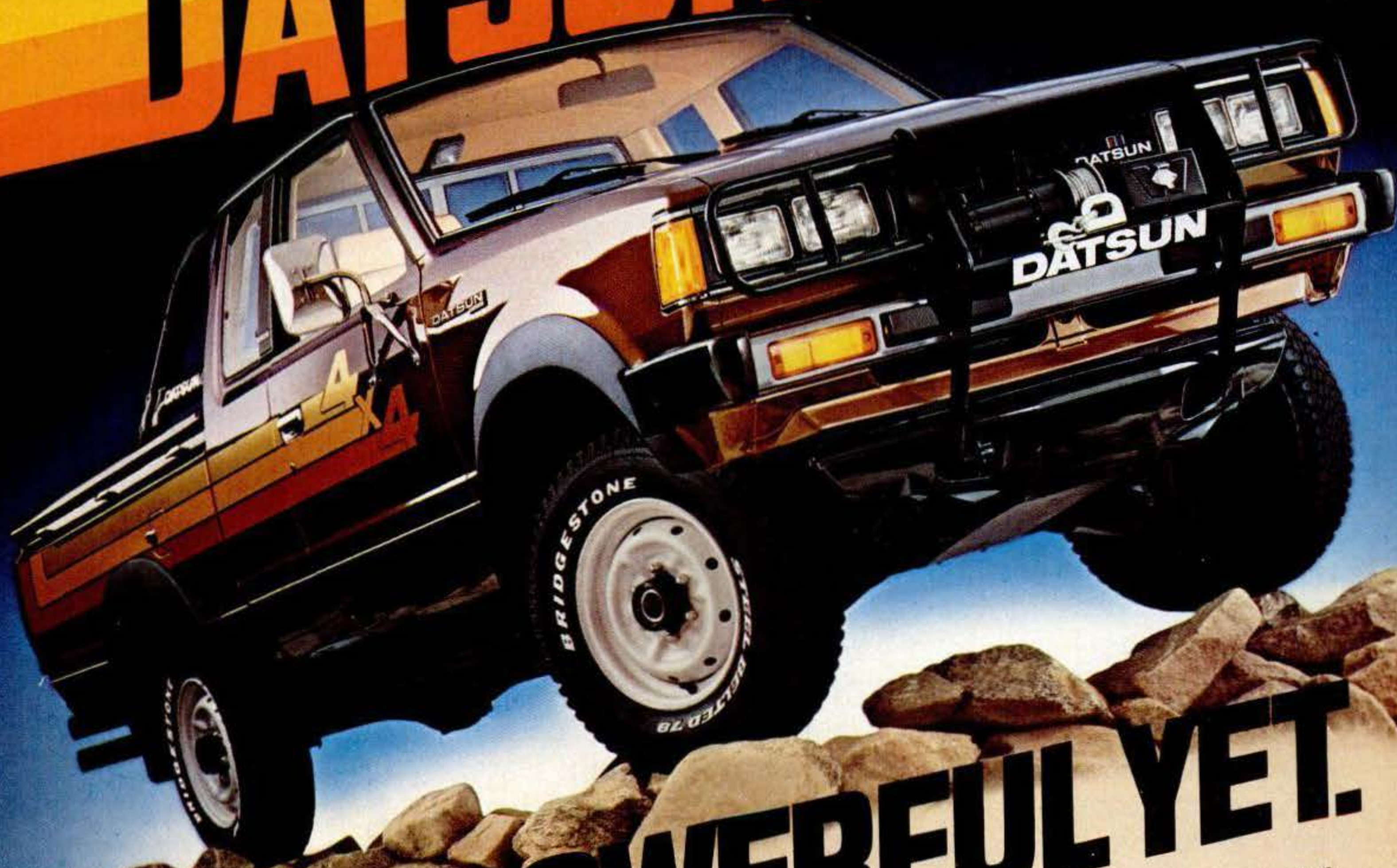
Actual Size:
6½" X 2½" X 2"

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DATSUN 4x4



MOST POWERFUL YET.

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Now you can ride off to the outback—and back—behind the most powerful engine ever in a Datsun pickup: the famous NAPS-Z. And it's in every Datsun truck.

This new 2.2-liter engine delivers more horses and torque than ever before—on less gas than last year.* What "engineuity!"

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To durability that has helped produce the best-selling compact trucks in history, Datsuns add a suspension that's perfect for the way you drive. The tallest minimum ground clearance in the class and 15-inch wheels help you step over boulders, while independent front torsion bars make them feel like boulevards.



Crossflow hemihead and two sparkplugs per cylinder allow the NAPS-Z engine to burn fuel more completely, leaving fewer unburned wastes in the exhaust.

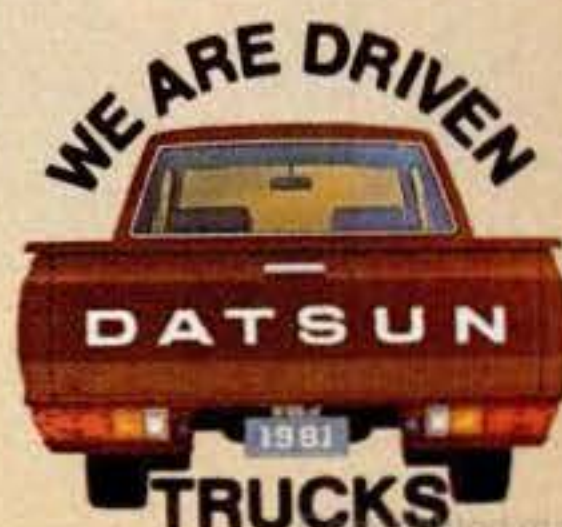
21 29
EST. MPG. EST. HWY.

*EPA estimates for comparison, with standard 5-speed. Actual mileage may differ depending on speed, trip length and weather. Highway mileage will probably be less. California estimates: **20 28**.

DATSUN KING CAB: ROOMIEST COMPACT GOING.

Enjoy the trip in the one-and-only Datsun King Cab, the pickup that's always civilized, even when the terrain isn't. Standard luxuries include steel-belted radials, 5-speed overdrive, tach, trip odometer and a truckload of extras, so you won't run out of extras, so you won't run out of extras, so you won't run out of extras.

comfort when you run out of road. You can even have jumpseats behind the reclining buckets. King Cab, Li'l Hustler,™ Long Bed...whichever Datsun you choose, off-road it only in designated areas. Respect for our wilderness is another way Datsun keeps truckin' for you.



"SAY, SMOKEY—"

A clinic on cars by Smokey Yunick, America's most famous mechanic

Baffling backfire

Under load, my '71 Jeep Wagoneer 232 backfires through the carburetor until the engine is fully warmed up. A new carburetor, ignition wires, manifold gasket, and a valve job have not helped. Fuel pressure and volume are okay. Raising the fuel level in the carb $\frac{1}{16}$ in. and increasing the choke setting helped slightly. The air pump was removed, various vacuum lines plugged, and the distributor retrofitted with a vacuum advance for a 1970 model (pre AIR vintage). No difference was observed. The intake manifold has no leaks. Manifold vacuum is slightly low at $16\frac{3}{4}$ in. The valve timing seems to check out okay.

We're stumped. Any ideas?

Dave Orum, Painted Post, N.Y.

Chances are you're running too lean (not enough choke) during warm-up. But late ignition timing or a plugged exhaust might also be the cause.

Is leaded fuel okay?

I have a 1980 Toyota pickup truck, model SRS (with the 2.2-liter engine and manual transmission).

Although the truck has no catalytic converters in the exhaust system, the owner's manual calls for unleaded fuel. Out of curiosity, I inquired at the dealer service department about why unleaded fuel was needed. I was told that engine damage would occur if leaded fuel was used. Is this so?

N. John Newbold
Duncan, British Columbia

Leaded fuel won't hurt an engine, as long as it is of the correct octane. But it increases polluting emissions.

Four-cylinder versus six

I have a 1975 Plymouth with a slant-six engine and 75,000 miles on the odometer. I haven't had any major problems with it. Could I expect the same service from the four-cylinder engine now being used in Plymouth and Dodge cars? How do they compare?

Harold Sprank, Muir, Mich.

About the same.

Engine pings

My 1978 Datsun B-210 pings, but only after it warms up and mostly on the highway. I checked everything possible and used premium gas, but this didn't help. Then I read that heated air coming through the preheater hose from the man-

ifold could cause preignition. Disconnecting the hose would stop the pinging. I asked a Datsun factory rep about this, and he said he had run across a few cars with this problem but didn't know what caused it.

My car had never done this until about three months ago. Would you have any ideas why it happened? Will running the car with the hose off hurt the engine or its performance? The only repair work ever done to the car was a new head gasket and a muffler, which I put on last July. By the way, the control valve for the heated air works.

Jerry Caron, Berkley, Mass.

Hot air enriches the fuel mixture because you have the same fuel flow, but with air that is less dense. Compression pressure also drops because hot air is expanded and is lighter by volume.

Generally, removing the preheated air hose is not a good idea. The results are likely to be an engine that stumbles until it reaches operating temperature—and reduced gas mileage.

Check the heated-air door in the air-cleaner snorkel. It should block off the hot-air hose after the engine is warmed up. I suspect it's not doing that, so you're getting preheated air through the carb all the time.

Rear-end noise

I have a 1978 Chevette. There is a hum in the rear end that comes in only during acceleration. The noise is less above 45 mph. I have had all new bearings installed, and there is no abnormal gear wear.

Paul Fedak, Nanticoke, Pa.

All rear ends make some noise. Don't mistake normal noise for excessive noise. Padding under the floor mats and seats can help reduce normal noise.

A bad mesh between the ring-and-pinion gears can cause excessive noise, which may be your problem. If so, the only fix is a new ring and pinion, carefully installed and adjusted.

Wants too much

I intend to pull a camper that has a 2,000-pound loaded weight and a 250-pound tongue weight. My car is a 1976 Pinto with V6 engine, automatic transmission, and 26,000 miles on the odometer. It is rated for 1,000-pound towing and 100-pound tongue weight.

The car will be fitted with a transmission cooler rated for 10,000 pounds GVW, transmission temperature gauge,

water-temperature gauge, air shocks, and a class-one hitch. Assuming I don't drive through any mountains, what kind of trouble can I expect from my car towing this trailer?

Gary Wohler
Mount Ephraim, N.J.

I'm afraid you're going to end up in a situation where the tail is wagging the dog. You'll overwork the car and be a hazard to yourself and others on the road. Don't forget, you're not going to pull this trailer strictly on flat, smooth roads with no head winds. What about hills, substandard roads, sudden defensive maneuvers, and panic braking? The game you want to play is dangerous, and you could end up a dead player. Don't do it.

Oil guzzler

My 1975 gasoline-powered VW Rabbit is using five quarts of oil every 1,000 miles. It has 46,000 miles on the clock.

Compression readings are 145, 155, 165, 165. After squirting in some oil, they're 175, 180, 180, 180. Plugs one and two turn black the fastest. I can see that some oil is being blown out of the crankcase vent (on the valve cover) and sucked in through the carburetor. What's wrong?

Richard R. Best
Fajardo, Puerto Rico

You've probably got stuck rings. Try adding Rislone (or a similar product) to the crankcase oil according to instructions on the can. If that doesn't help, remove the head. Install new valve guides and seals. Check the piston rings; free them up or replace as necessary.

Fuel boils in carb

My 1975 Honda Civic with a CVCC engine has performed very well for 61,000 miles, with one irritating and dangerous exception: The fuel in the carburetor boils violently and floods the engine almost every time it is stopped for more than a few minutes at normal operating temperatures. During hot weather, it requires several blocks to run smoothly after hot starts and fills my garage with fuel vapors after shutdown.

The local Honda dealer says that it's a design problem with no known cure short of trading for a newer model. What do you say?

Duane Ottmar, Springfield, Mo.

You need a baffle between the intake manifold and the carb float bowl to block off some of that heat, and an air-duct hose running from the grille to the carb.

Each month, Smokey Yunick answers questions on cars—family cars, high-performance models, and racing vehicles. Got a problem? Send it to: "Say, Smokey—", Popular Science, 380 Madison Ave., New York, N.Y. 10017. Smokey reads all letters, answering those he feels are of widest interest. Due to the large volume of mail, Smokey cannot reply to letters that are not answered in his column.

SCIENCE NEWSFRONT

By ARTHUR FISHER

New cryogenic alloys

Conventional structural steel has a decided handicap at very low temperatures: Even the strongest will fracture like peanut brittle. That means that pressurized tanks used to store and transport liquefied natural gas, liquid nitrogen, and other gases at cryogenic temperatures must be made of stainless steel. Stainless resists shattering but is very expensive because stainless alloys contain large quantities of (mostly) imported nickel.

Now researchers at the University of California's Lawrence Berkeley Laboratory have developed two new nickel-free steels that are virtually immune to impacts at temperatures hundreds of degrees below zero Celsius. The breakthrough came by modifying the grain structure of the alloys, in one case through adding boron, an element abundant in the United States. The LBL team, consisting of J. William Morris, S. K. Hwang, and N. Niikura, has been commended by the Department of Energy's Materials Science Program for making the most significant contribution among nine DOE labs in the energy-related fields of metallurgy and ceramics in 1980.

Fiber-optics fix

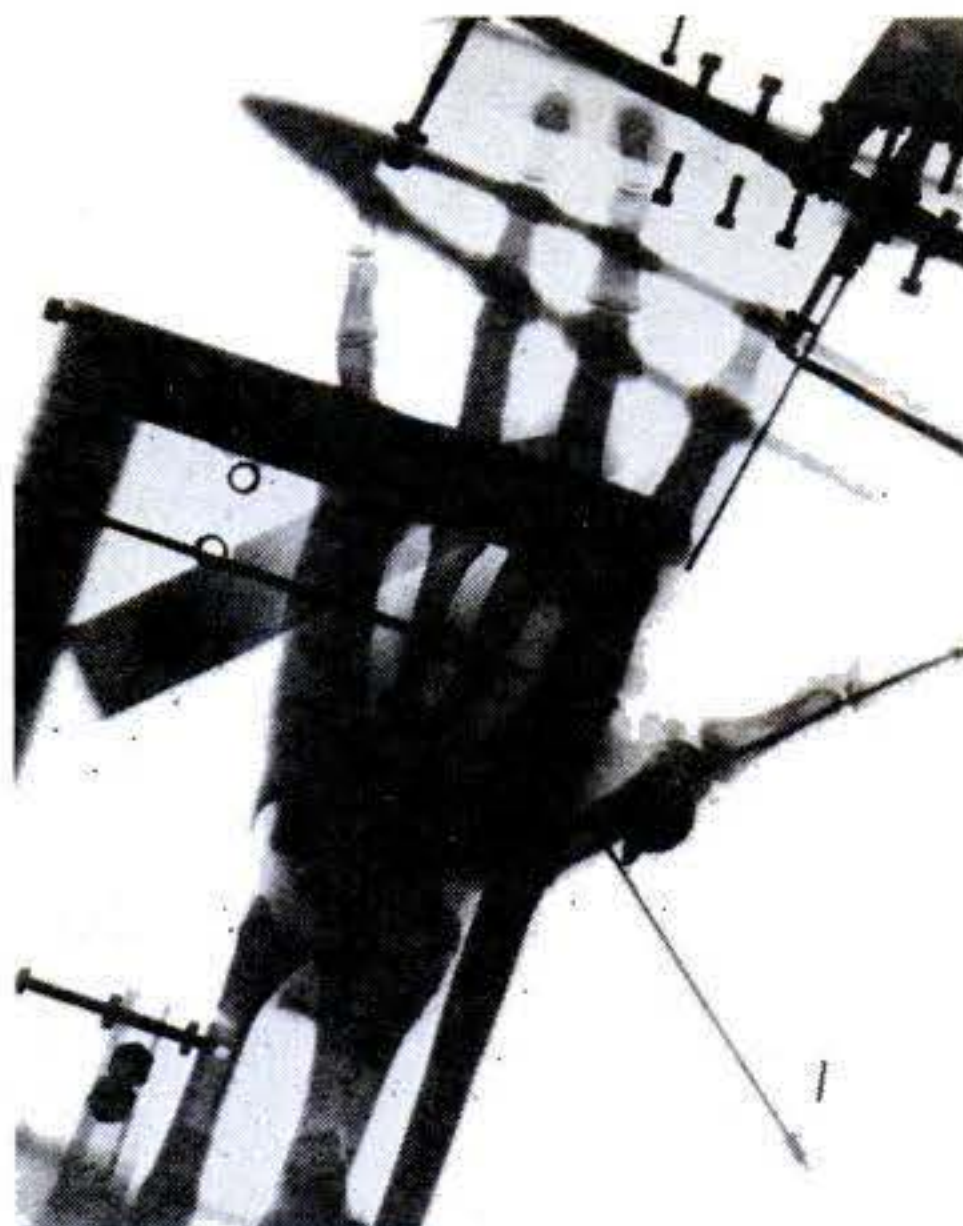
Physicists at IBM's Research Division have found what may be a remedy for a problem faced by long-distance light-wave communications. In the photo below, Daniel L. Grischkowsky, left, and Hiroki Nakatsuka are monitoring picosecond pulses of laser light transmitted

through a very long optical fiber—the glowing object at right center is actually a coil of fiber 300 meters long. The problem is that the pulse is distorted by dispersion as it travels. The dispersion stems from the fact that longer wavelengths of light travel faster than shorter ones in the glass fibers. But research had shown that a laser pulse traveling through an alkali metal vapor would, under certain conditions, display exactly the opposite effect, with shorter wavelengths traveling faster than longer ones. Therefore, it should be possible to recompress the pulses by passing them through vapor. In the IBM experiments, a metal-vapor cell just 50 centimeters across exactly compensated for the dispersion in 300 meters of optical fiber. By providing for multiple passes through such cells, messages traveling over kilometers of fiber could be recompressed.

Diesels and soot

"A car with a diesel engine will get 25 more miles per gallon than the same car with a gasoline engine," says Dr. Richard Sapienza of Brookhaven National Laboratory, "but at the same time, the diesel car emits about 13 pounds of soot every 10,000 miles," about 50 times as much as the gasoline-engine car. And therein lies a dilemma that Dr. Sapienza and his colleagues are trying to resolve.

Environmental and health experts worry about the effects of this kind and amount of soot, which is mostly carbon but can carry a variety of hazardous pollutants. Although more research needs to be done before definite conclusions can



be reached [SNF, PS, Jan.], a number of studies have linked diesel exhaust with emphysema and other respiratory ailments.

Dr. Sapienza told a spring meeting of the American Chemical Society that adding small amounts of alcohol to the diesel fuel and platinum to the walls of the engine reduced soot by 80 percent in preliminary tests. He noted that automotive engineers believe soot is formed during combustion—in the fuel-air mixture and on the sides of the combustion chamber. Both the alcohol and the platinum engine coating are thought to trap soot precursors, or "seeds," before solid particles of soot can coalesce. Present exhaust treatments, such as traps, are designed to control soot after it has formed—"when it is already a problem," says Dr. Sapienza.

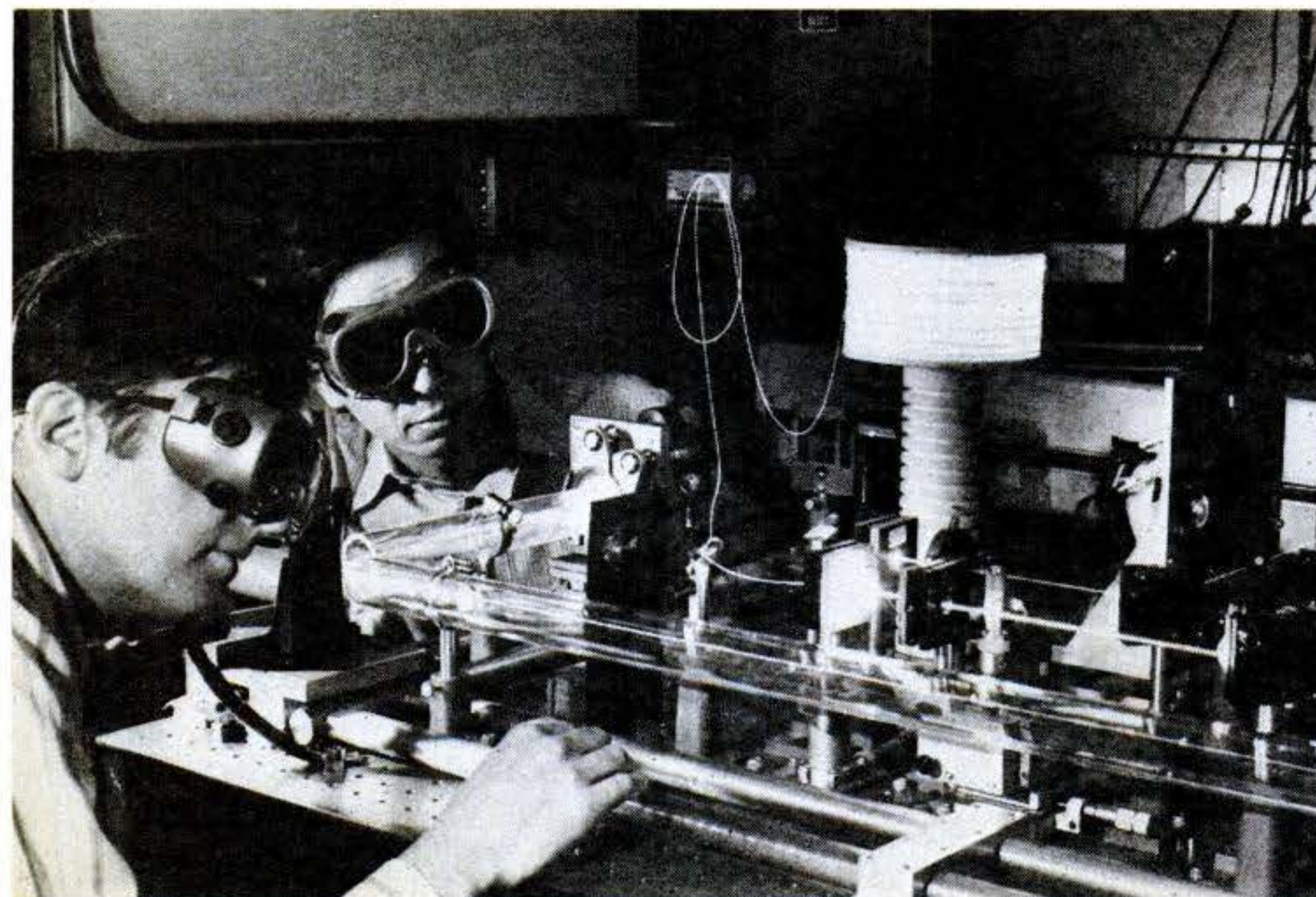
Modeling the hand

The device in the X-ray photo above is being used by a team of mechanical engineers, orthopedic surgeons, physical therapists, and others at Louisiana State University to create a complete mathematical model of the human hand. David Thompson, a professor of mechanical engineering at LSU, feeds data on how various bones, ligaments, tendons, and muscles interact into a computer, which checks the fit using the model's equations. Team members can compute how various changes in the anatomy of the hand, caused by accident or disease, will, in time, affect hand motion. Eventually, the model will help surgeons and therapists correct deformities more effectively.

Milestone molecule manifested

Guess how many uniquely individual chemical substances have been reported in the scientific literature since 1965, when the American Chemical Society's Chemical Abstracts Service began keeping track. More than five million, you say? Quite correct. The five-millionth, recorded last winter, is a new plant alkaloid discovered by scientists at the University of Pennsylvania. It is named, appropriately, Grandirubrine.

Continued



OH SAY
CAN YOU
SEE?

Let's bring Fourth of July drinking into focus.

There are signs that warn us when we are overdrinking. We may lose our coordination. Our speech may become slurred. Even our vision may be momentarily impaired.

We will all have a safer and happier holiday weekend if we take the following simple precautions:

STOP: Take your last drink of the day hours before you plan to leave for home.

LOOK: This weekend, even cautious drivers should become more cautious, especially at night. After dark, the number of alcohol-related auto accidents increases.

LISTEN: Ask yourself, "Have I had too much to drink?" Then listen. If the answer is yes, don't drive.

Whenever you've had enough, a little flag should go up to tell you. And we salute those who obey that flag this Fourth of July.

The House of Seagram

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You've got the whole band in your hand.



Now Casio introduces five instruments and a rhythm section—in the new VL-Tone.



The Casio VL-Tone is an amazing new instrument that's so advanced, even a person who's never tried playing Chopsticks can compose a recognizable song, the first time out.

The secret is Casio's development of a very small computer chip that has a very large capability. With it, the VL-Tone lets you pick any one of 5 different instruments to play; record up to 100 musical notes and play them back; select pitch and tempo; go up and down 2½ octaves; and if you want to hear the beat of a different drum, choose from 10 pre-programmed rhythms that swing

from rock to rumba.

The VL-Tone is battery operated and has its own speaker or can be plugged into a hi-fi or professional amplifier. And, so portable you can take your act anywhere.

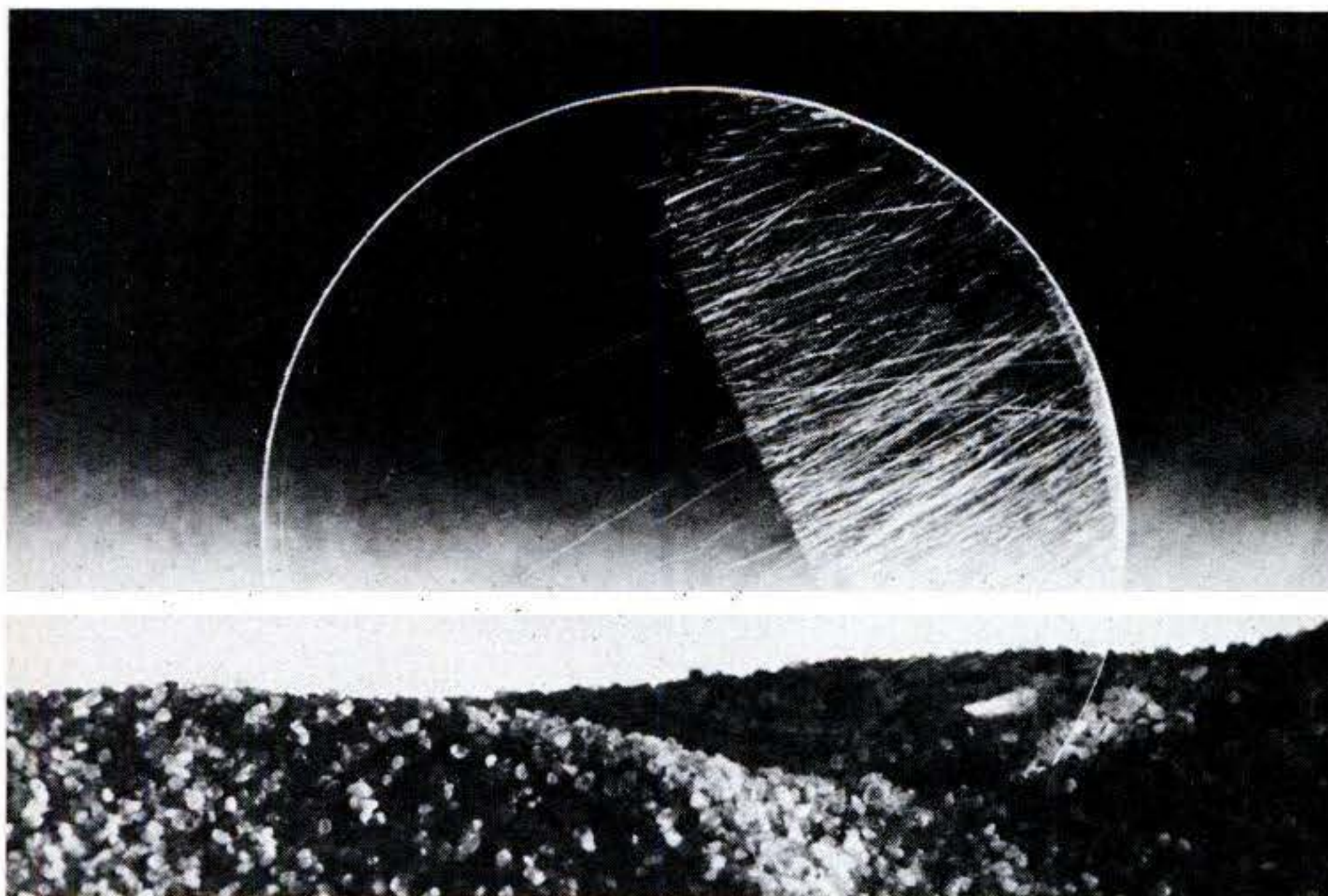
Even more amazing, in addition to being an incredible musical instrument it's also a full-function calculator.

So, if you're known as a one-fingered player or an accomplished musician, the Casio VL-Tone can put a whole world of music in the palm of your hand. As well as a song in your heart.

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[Continued]



Oil picker-upper

A new and powerful device for removing oil from marine environments—even when the oil is frozen—has been developed by a Swedish engineering firm: Oljedestruktion AB Arne Larsson of Sol-lentuna. The unit can be mounted on a ship or between pontoons, or suspended from a helicopter. Its business end consists of a horizontal, rotating screw-pump drum approximately eight feet long and 2½ feet wide. The drum has raised edges that form threaded channels converging on the drum's center. Powered by a 170-hp diesel engine, the drum sucks oil through an inlet and into storage tanks via a drainage pipe.

Out, out, damned scratch!

American Optical Corp. has introduced a new coating for plastic eyeglass lenses that it claims results in greatly increased resistance to scratching. Scratches on plastic lenses are a common annoyance, especially for those who are given to cleaning their glasses on neckties, bar cloths, antimacassars, or anything else handy. The photo above demonstrates the effectiveness of the new coating, called Permalite. It shows a plastic lens, 60 percent of whose surface has been protectively coated. After coating, the lens was rubbed with steel wool over both coated and uncoated parts. The difference is, shall we say, clear.

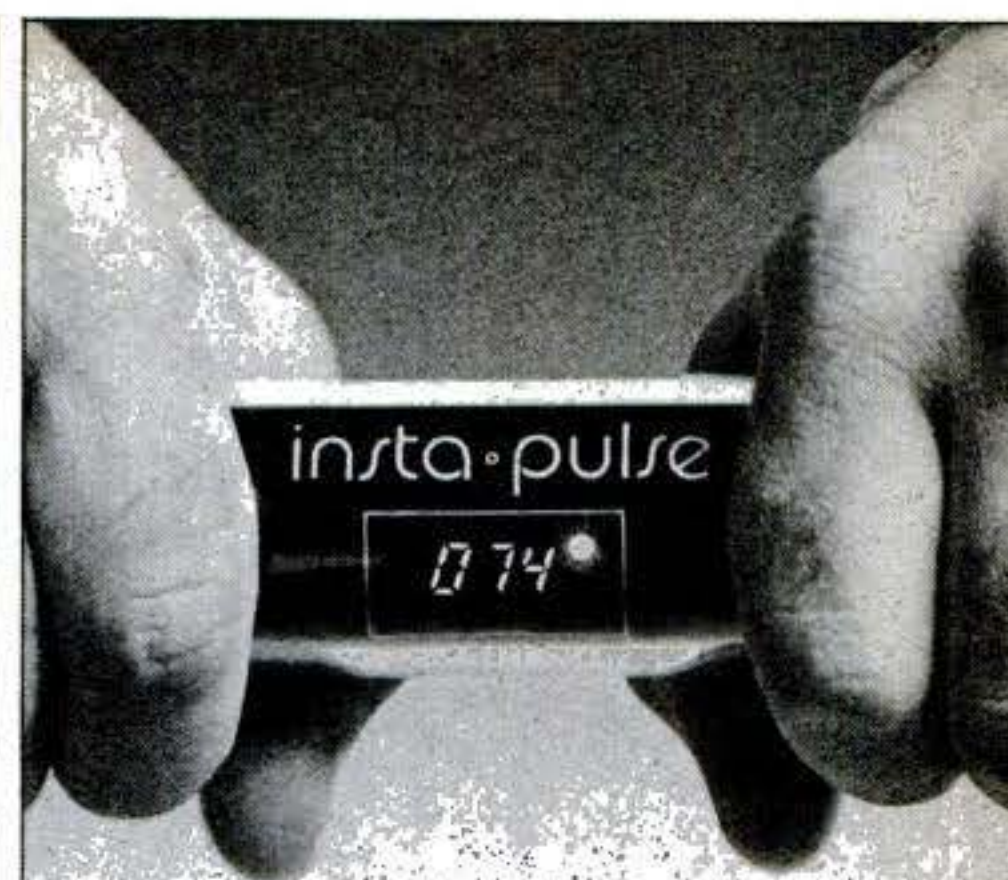
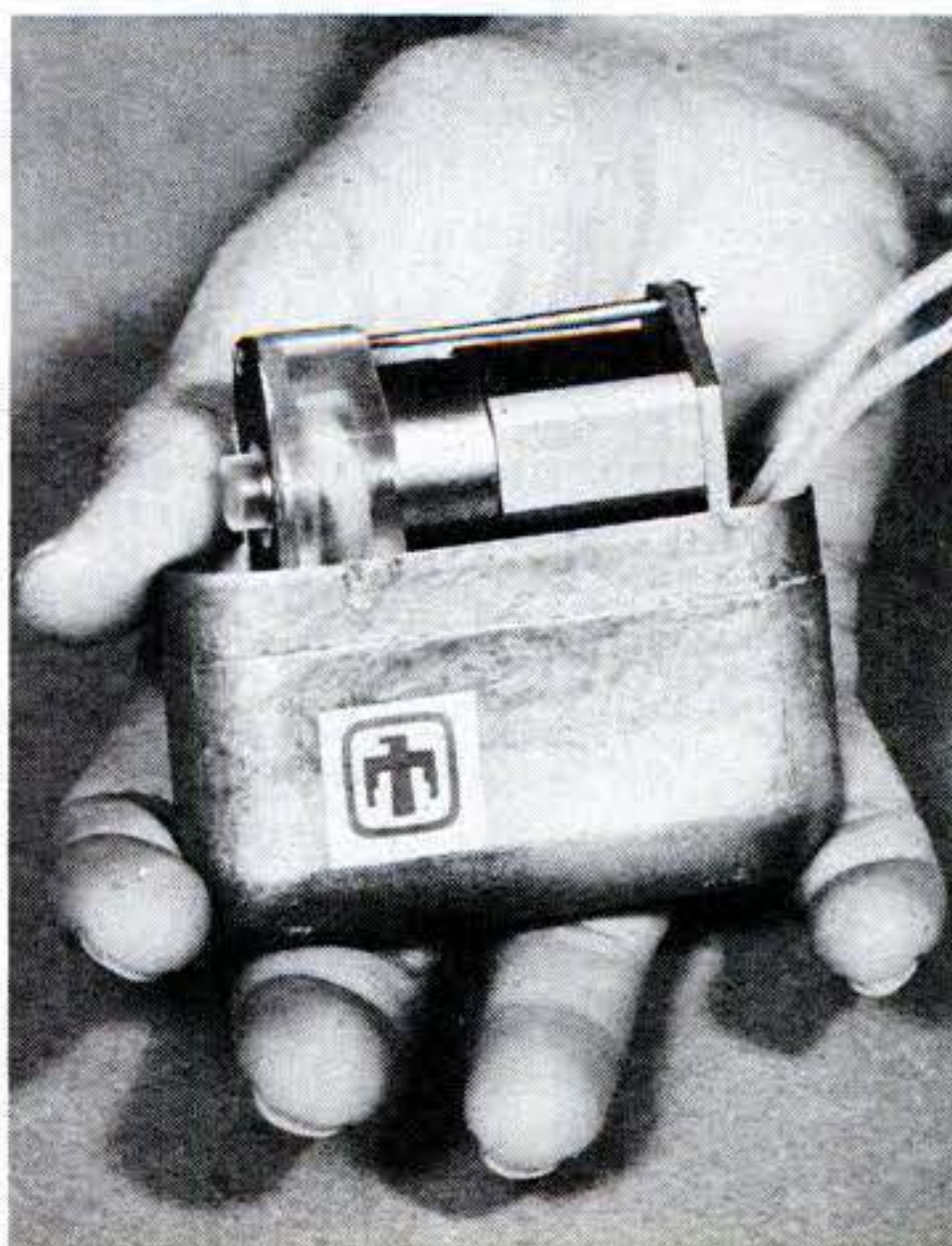
Implant for diabetics

Surgically implanted pacemakers for patients with heart disease have been responsible for maintaining many thousands of lives ever since they became commonplace. Now the implant idea has been extended, experimentally, to cope with another major health problem—diabetes. Developed by Sandia National Laboratories and the University of New Mex-

ico School of Medicine, an electronically controlled unit that delivers insulin on a programmed basis has been temporarily implanted in the abdomen of a 41-year-old diabetic man.

In diabetes, the ability of the pancreas to manufacture insulin is impaired, and many diabetics require daily injections of the hormone. The new implant works much like a normal pancreas, except that insulin is pumped into the patient's abdominal cavity, where it enters the portal vein and flows to the liver.

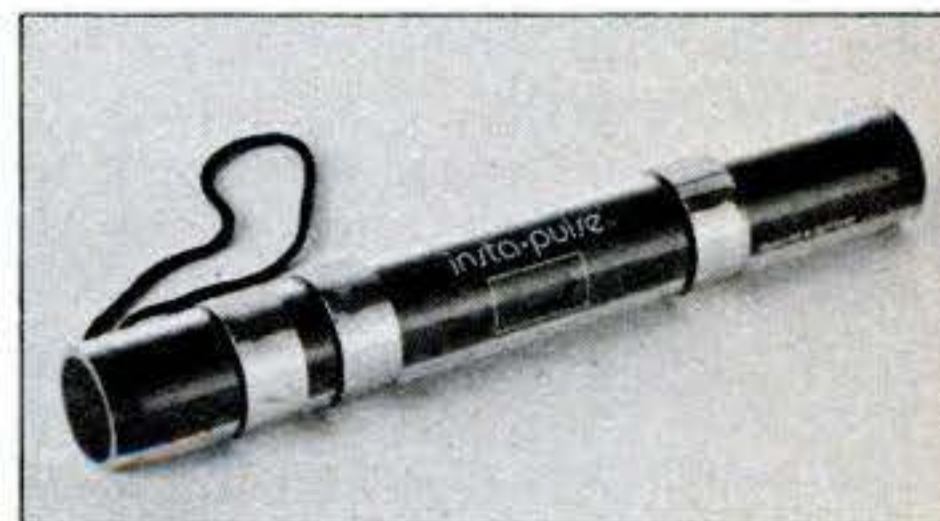
In the photo below, the top of the unit's case has been removed to show its tiny pump and motor, which, with electronic controls and two lithium batteries, are enclosed in a thin titanium case to make up an 11-ounce package. Key to the system is a peristaltic pump driven by a solenoid motor originally built at Sandia for a weapons-control system. The patient varies the amount of insulin delivered, according to dietary input, with a handheld programmer. **P 5**



INSTA-PULSE

The most advanced way to take your pulse is Insta-Pulse, developed by neurophysiologists and engineers at Biosig, Inc. Portable and rugged, Insta-Pulse gives you instant LED digital readout of your heart rate, and a flashing dot shows each beat. Turns on and off automatically when you grasp the nickel bands. And Insta-Pulse is the only heart rate monitor that works on the same principle as a hospital electrocardiograph (EKG). About the size and feel of a running relay baton, 11" long, 1½" in diameter, and weighs only 10 ounces. Strikingly designed in black and white, encased in clear lucite. Shock resistant too. And Insta-Pulse consumes so little power that its 9-volt battery lasts up to one year. Comes with one year limited warranty, and The Sharper Image 2-week return privilege.

Heart rate is a primary indication of how the body is reacting to exercise, stress, or the people in your life. With Insta-Pulse, you'll have this information literally at your fingertips.



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Programmed cooling

improves your comfort,
lowers your energy bills

Microprocessor controls in window air conditioners and whole-house systems give new flexibility

By EVAN POWELL

Microcomputer-based controls have added versatility, reliability, and accuracy to many new appliances and tools. Now computerized air-conditioning systems can bring additional benefits: greater comfort, energy economy, and easier servicing.

Computerized air-conditioning controls automatically adjust temperatures upward at preset intervals for greater energy efficiency. You needn't waste electricity cooling rooms when no one is around. And recently, testing a new Sears computerized window model, I discovered some fringe benefits: A built-in computer can help prevent compressor overheating and damage following a power failure, and it can shut off the unit during low-voltage brownout conditions.

Microcomputers are also being used with heat pumps. And a number of companies are marketing retrofit computerized controls for existing air-conditioning and heating systems ["Computerized Thermostats," PS, Oct. '79].

Temperature economy

The versatility of computer programs ensures the most economical operation from your cooling system. The value of temperature set-back for heating (and set-up for cooling) has been established in several studies.

A "real-life" two-year study sponsored by Honeywell at Edmond, Okla., verified previous computer simula-

tions [PS, Oct. '80]. Honeywell also found that, for cooling, homeowners saved most when they set their thermostats up by five degrees or more for 17 hours per day.

"It's very important to set up during the right part of the day," says Cliff Moulton, manager of marketing for Honeywell. The ideal set-up time for most homes in the Edmond study was 10 a.m. to five p.m.—hours when family members are likely to be out. The families whose homes were monitored by sensing devices and recording equipment saw energy bills drop an average of 23.4 percent from May to September.

Comfort is another benefit with computerized control. While testing a General Electric control for heat pumps, GE's manager of applications engineering, Chuck Erlinson, installed the microprocessor unit in his home with special circuits so the existing conventional thermostat could be switched in and out. Chart tracings of temperature made during the monitoring period were much more constant for the microprocessor unit than for those with the conventional thermostat.

This corresponds to my findings at our studio-experimental home with a SmartStat 1000 coupled to a Coleman high-efficiency heat pump. The SmartStat, marketed by Johnson Controls, is a programmable set-back/set-up control for heat pumps that replaces an existing thermostat.

Reliability is another reason for using computerized controls. I've found that any electronic device that's going to fail will usually fail within the first few weeks of operation. That's covered by the warranty. After that, there's none of the mechanical wear and arcing that occurs in conventional

controls and reduces their operational lifetimes.

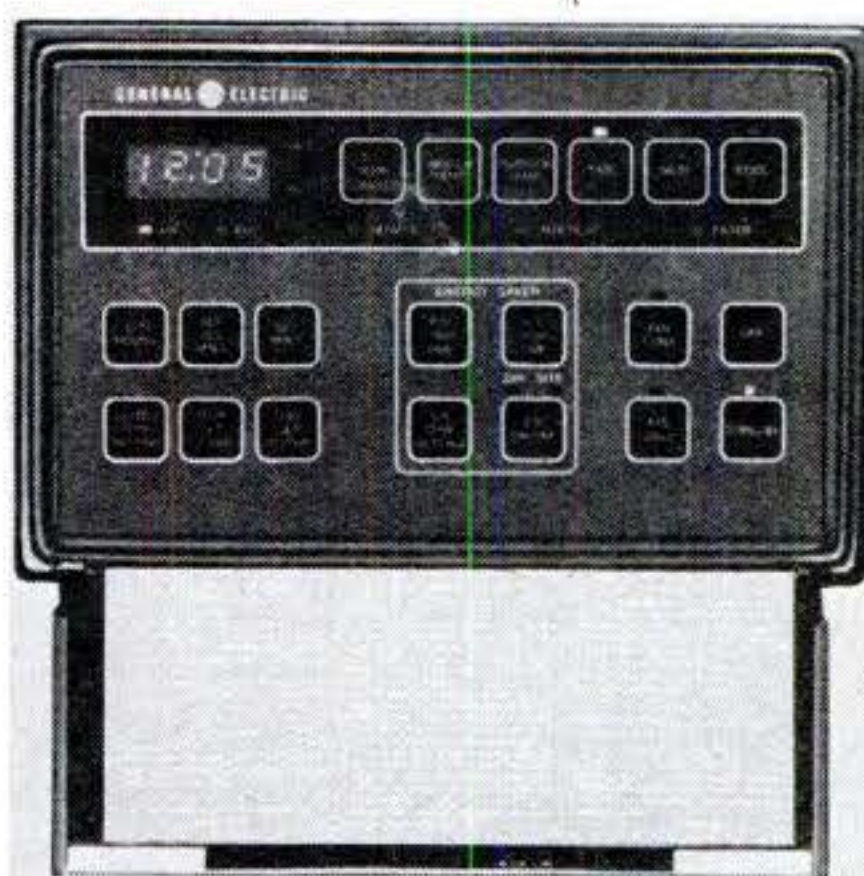
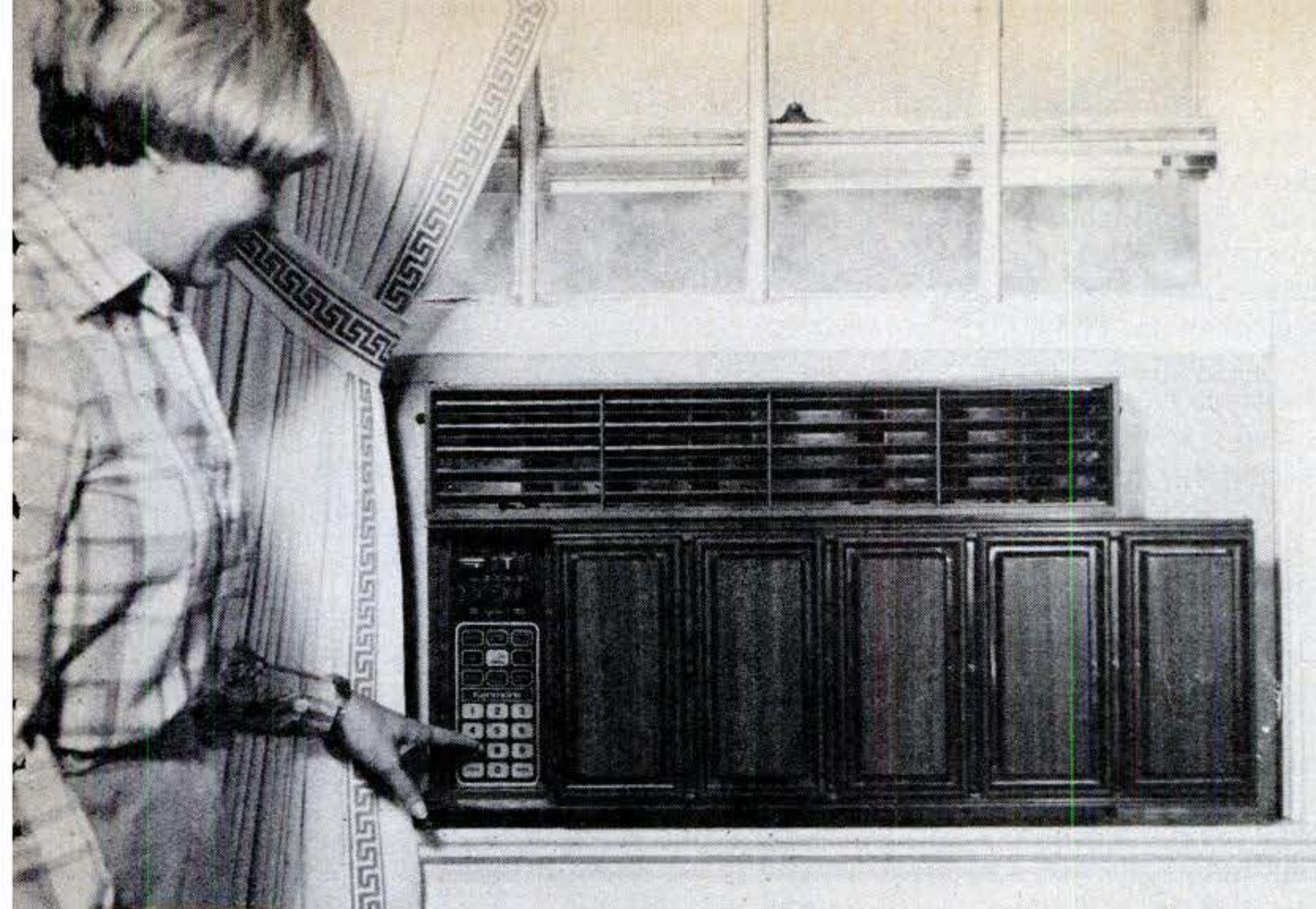
Computerized room cooling

Sears' model 17905 is the first window air conditioner to use computer-control technology. I discovered its versatility during the pleasantly warm but humid days of early spring in South Carolina. Tap the HUMIDITY CONTROL pad on the touch panel and the unit cycles on at intervals to remove moisture with minimum cooling. According to Sears, it's the equivalent of a 20-pint-per-day dehumidifier. The control gradually slows the fan as the desired temperature is reached, keeping power consumption and noise down. Electronic temperature sensing keeps temperatures very consistent.

Short-cycle protection is another feature built into the Sears unit. In conventional models, a brief line-voltage interruption can damage windings when the compressor attempts to restart before pressures equalize and unlock the rotor. The Sears model prevents this by delaying start-up for three minutes after power returns. You have to reprogram the computer after a power interruption.

Another protective bonus in the Sears microprocessor control is built-in brownout protection. If the voltage falls below a predetermined level, the unit shuts off until the normal power level is restored.

But the microprocessor's most important job is controlling set-up periods when no cooling is required. In the Sears unit, this takes the form of an on-off cycle. You set the shutdown time by touching the OFF TIME pad, then programming the time you'll leave home. Next, touch ON TIME and enter a time about one hour before your return. This program stays in the



Front panel of computerized air conditioner from Sears (top left) slides open to reveal sophisticated controls. Touch pads (top right) let you enter night setting, start-stop times, humidity control. York's thermostat for its Enmod heat pump (left) also lets you program automatic night set-ups for energy savings. GE's DMC 2000 control (above) indicates time of day and indoor or outdoor temperatures.

unit's electronic memory until it is changed or erased. On weekends or at other times you can override it by touching the **TIMER ON/OFF** pad.

The **NIGHT SETTING** pad and its program allow the temperature to rise four degrees one hour after you touch it and go to bed. Five hours later, before wake-up time, the thermostat returns to the original cooling setting.

The high-efficiency (9.6 EER) 9,000-Btu Sears model sells for about \$550 and should be available nationally by the time you read this.

Central-cooling controls

I've already mentioned the Smart-Stat, the first set-back/set-up control intended for heat-pump systems. Now there's a new kid in town. General Electric's DMC 2000 operates only

with its new Executive II heat pump, which features a two-speed compressor. The 2000 has a self-diagnostic feature, which monitors sensors within the system. If anything gets off course, a service light alerts the user to notify the repair department. The service technician plugs in an analyzer, and the control indicates the trouble area.

The DMC 2000 provides up to two temperature changes a day, and its display can also indicate outside temperature. When remote sensors are used, it averages the input for an indication of temperatures throughout the house. The **STANDBY** pad keeps temperatures in an unoccupied home from rising above 85 degrees F or falling below 55 degrees.

York's computerized control, used in conjunction with a Yorkguard com-

puter module in its heat pump, also provides a self-diagnostic feature. Electronic sensors control defrost time and auxiliary-heat input based on actual outdoor conditions.

York has also put microcomputer technology to work in its Enmod residential heat pump. In this model, which costs about twice as much as York heat pumps with single-speed compressors, the speeds of both the compressor and fan are varied. Instead of cycling the compressor on and off, the Enmod modulates the 60-Hz line current to lower frequencies, using a new inverter and microcomputer control to vary compressor and fan speeds. The company claims Enmod consumes 17 percent less energy than its conventional heat pumps.

Retrofit controls

Both Honeywell and Texas Instruments are marketing retrofit computerized controls for air-conditioning and heating systems, but not for heat pumps at this time. TI's 4FA23 has three independent operating modes that give a total capability of seven different temperatures and six different times. It wires directly into the existing 24-volt thermostat circuit in most cases, although oil furnaces and gas furnaces with electronic ignition may require the addition of an isolation relay.

Honeywell's T-800 control, also for conventional heating-cooling systems, allows for day and night set-back and set-up periods. A **FIVE-DAY/SEVEN-DAY** selector switch allows you to skip the day set-back period on weekends.

All of these central controls have self-contained batteries to prevent loss of programs during brief power outages.

Aluminum fireplace — top-to-bottom heating system

Ignite a log in a fireplace, and it gives off heat. That's basic. But ignite the same log in a fireplace system, and everything gives off heat. That's the basic idea behind the Trophy aluminum fireplace.

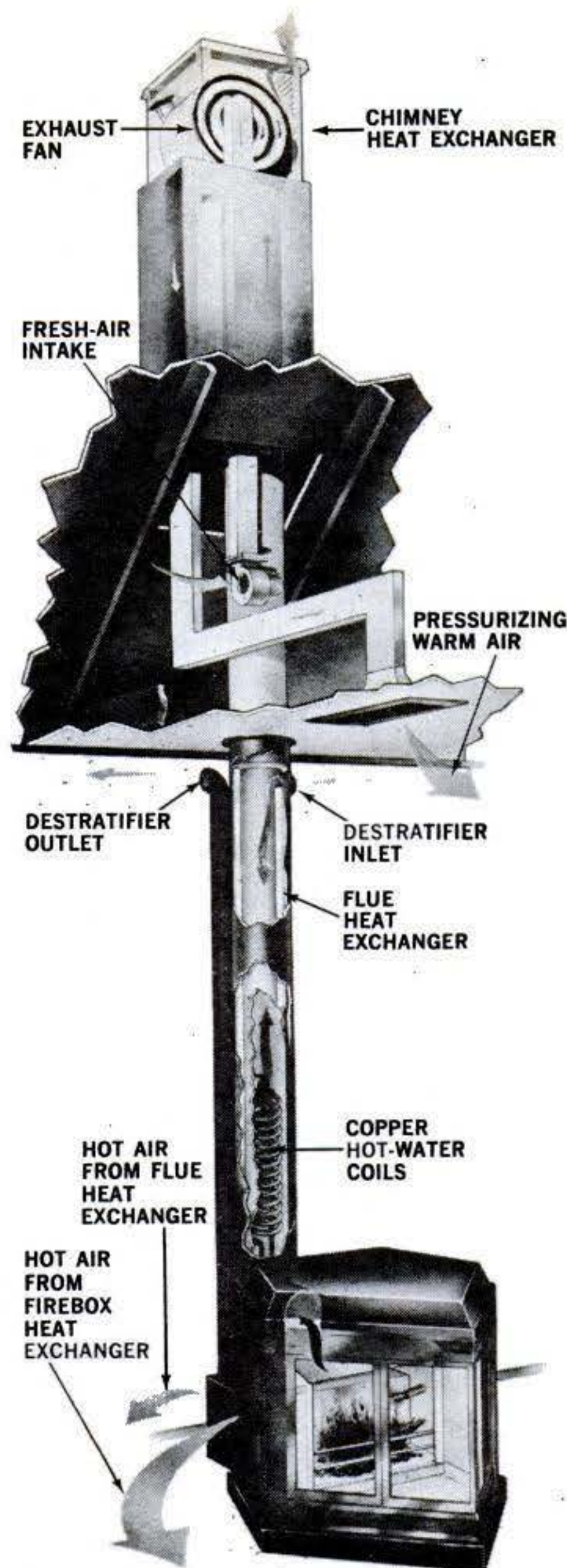
Heat normally lost up the chimney is recovered in a variety of ways to account for an impressive 70-percent fuel efficiency. The system not only gives off more heat but is specifically designed to distribute it more evenly. According to Trophy's maker, the room is warmed, literally, from top to bottom.

The fireplace is constructed of steel tubing that acts as a heat exchanger. A fan pulls in cold air from the floor, circulates it through the firebox exchanger, and blows the warm air back into the room. Fresh air is blown over the fuel at the same time to create a blowtorch effect. The resulting hot fire is said to burn gases and tars, minimizing pollution and creosote build-up.

Inside the flue, air ducts encircling the stovepipe act as a heat exchanger. A fan draws air off the floor in the room, circulates it through the ductwork in the stovepipe, and returns it to floor level after it has been heated and filtered.

To keep temperatures equal at all levels of the room, a "destratifier" duct runs along the outside of the stovepipe. Hot air from the ceiling is passed down to the floor; cold air from the floor circulates to the ceiling. The heavier cold air filters down, destratifying heat layers and equalizing the temperature from floor to ceiling.

At the chimney, another heat exchanger is said to capture 48 percent of the heat that would normally escape. The exchanger warms fresh air from the attic and forces it back



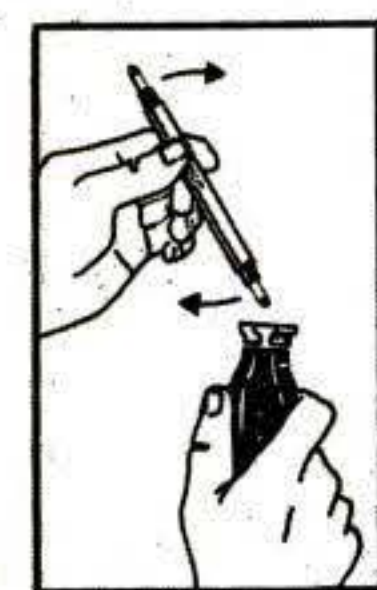
down through a vent into the room. The additional air pressure created, claim the system's designers, pressurizes your entire home. This prevents outside cold air from entering through window and door leaks.

The top heat exchanger is actually an option and is adaptable to conventional fireplace stovepipes. Another optional component, a copper hot-water coil, fits in the stovepipe just above the firebox—the hottest part of the system. Water passing through the coil is heated and can be used for hot-water baseboard heating in other rooms.

The fireplace is covered with a 27-by-30-inch star-shape aluminum shroud. This has high thermal conductivity, yet stays relatively cool for added safety. The system will burn wood, fire logs, and coal.

The Trophy system is sold by Cadet Mfg. Co., Box 1685, Vancouver, Wash. 98663. Price: \$1,200 plus options. Option prices have not yet been determined.—William J. Hawkins

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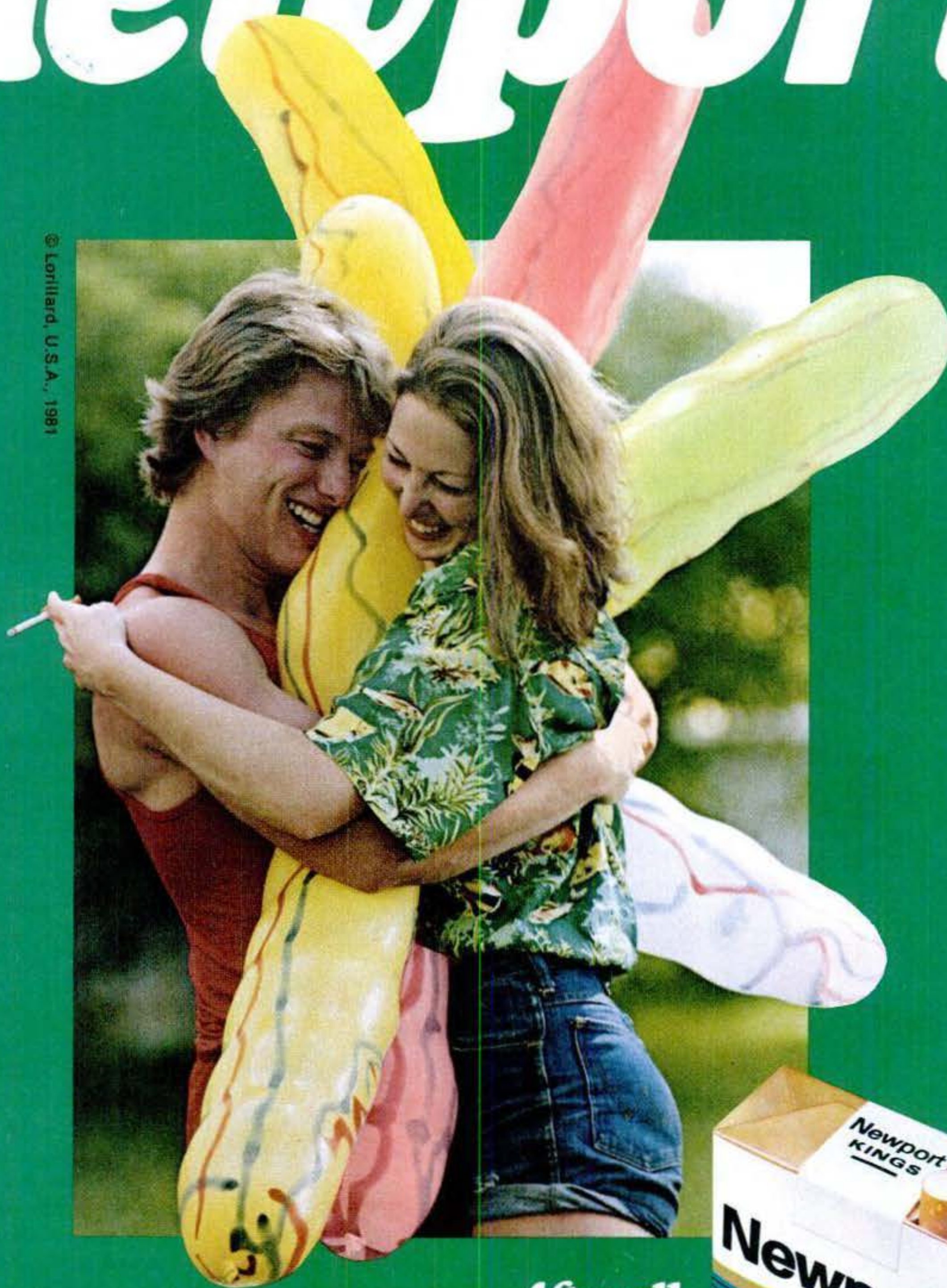
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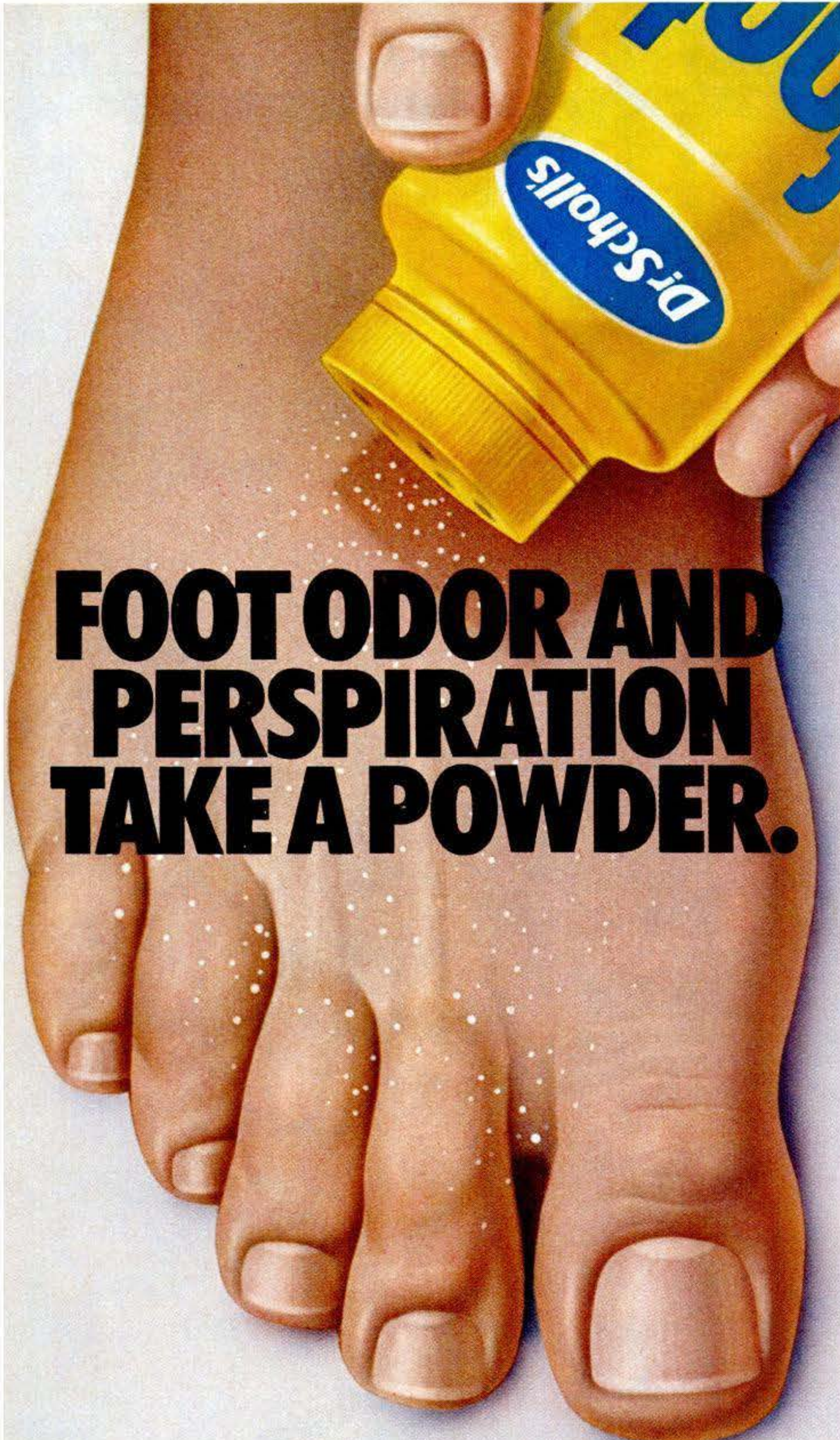


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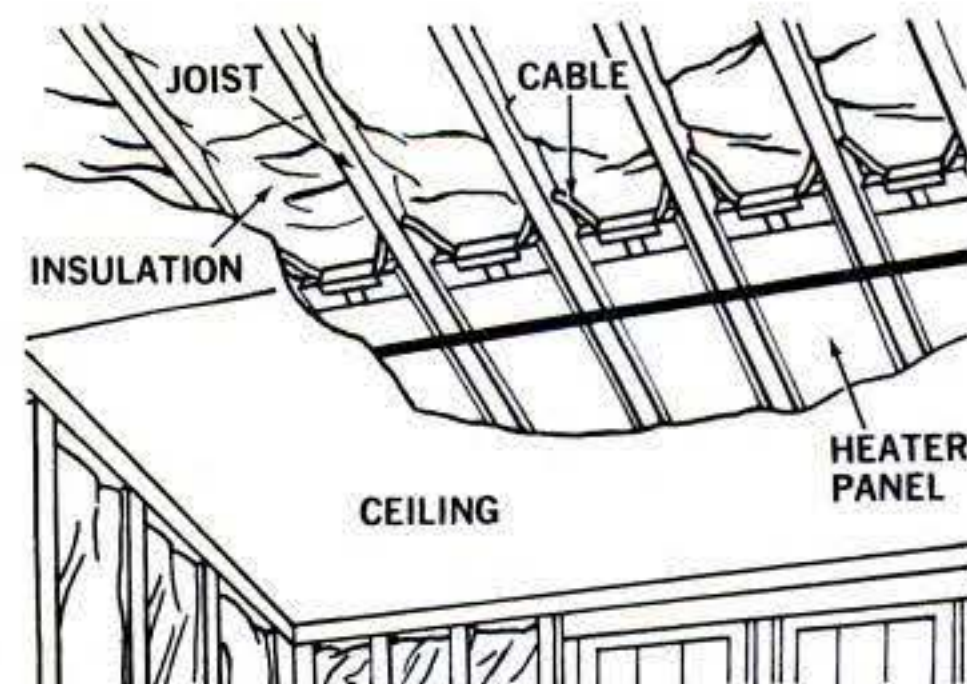
If you're worried about foot odor, just remember: it takes a powder from Dr. Scholl.

Dr. Scholl's

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Hidden heaters cut electric bills



The only way you know that a room's heated with Therma-Ray is by noting what's missing. There are no radiators, no registers, no baseboard units. The Therma-Ray radiant-heating system hides behind the ceiling.

Therma-Ray radiant-heating panels are half-inch-thick gypsum-board rectangles embedded with coils of insulated nichrome wire. The panels come in eight-, 10-, and 18-inch widths so they can slide in between ceiling joists, below the insulation (see illustration). The panels are wired in parallel and connected to a thermostat. Then a regular gypsum board or plaster ceiling is put up.

Panel lengths vary from three to 21 feet. A standard heat-loss calculation determines the number and size of panels needed. To keep a typical 16-by-20-foot room at a comfortable 70 degrees F when it's zero degrees outside, you'd need seven of the 10-ft. panels. With thermostat, this installation costs about \$154.

Besides its relatively low initial cost, the Therma-Ray system is claimed to be thermodynamically efficient. The heating panels warm the ceiling directly by conduction. Then the air just below the ceiling spreads the warmth evenly across the whole ceiling by convection. The ceiling becomes a thermal storage mass, radiating the stored heat to the cooler objects in the room—including people. The design makes it possible to operate the radiant-heating panels at temperatures as low as 95 to 100 degrees F, cutting operating costs.

A three-year study conducted by Therma-Ray (Box 516, Old Saybrook, Conn. 06475) compared heating costs in 20 New Hampshire homes using the system with the estimated costs of standard radiant heating in the same homes. The annual savings, says the company, ranged from 10 to 51 percent, depending on individual use.—*S. Renner-Smith*

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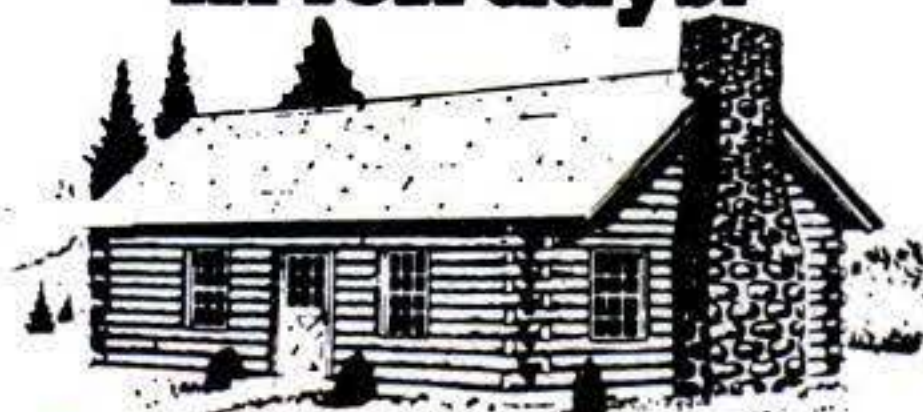
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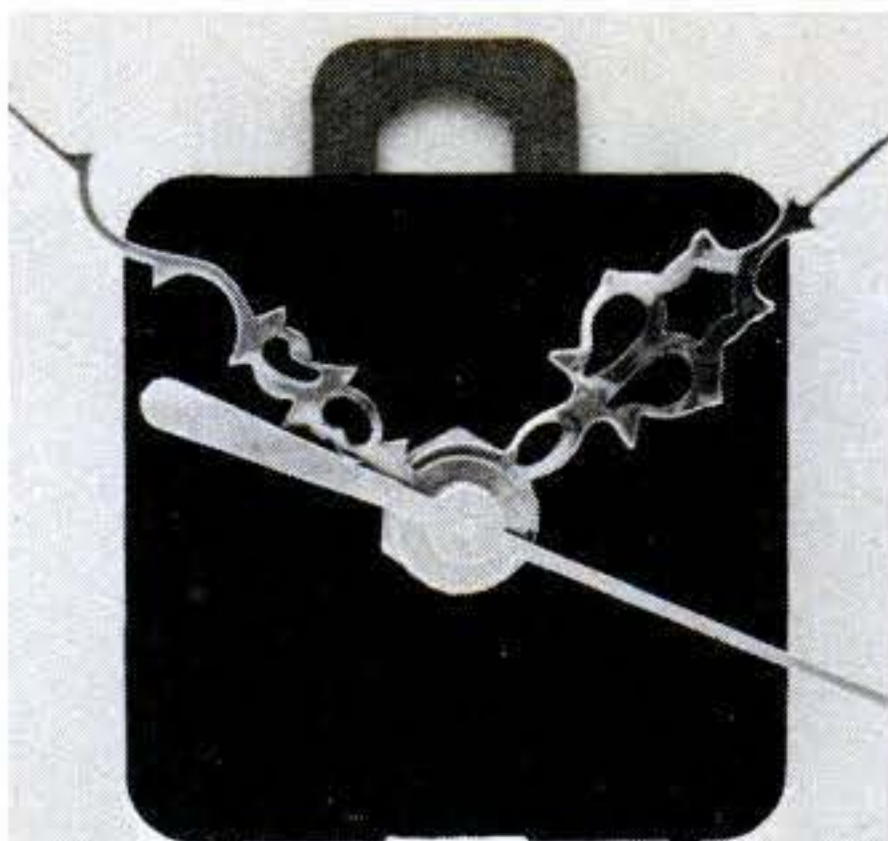


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Variable-stroke screw-driven log splitter

"Archimedes thought of it first," said Russ Heidner, the Gilson representative who was explaining the company's new all-mechanical log splitter. True enough, the screw principle used to force the wedge through the log goes back to ancient—and very sound—engineering.

Gilson's Power-Bolt splitter uses a huge, internally threaded drive nut rotating on an equally huge, plated drive screw (the power bolt) to drive the ram. No hydraulic pumps or cylinders are involved, and the splitting force is variable, using only enough to split each log.

As I watched, Heidner put a 24-inch log on the beam and flicked the control lever. The ram drove the heavy oak log against the wedge and effortlessly popped it apart. Then the ram retracted automatically. Operating speed is about the same as with a hydraulic log-splitting unit. The novel feature is that you can quickly and easily adjust stroke length for a shorter or longer log. Since the stroke length is not controlled by a fixed-stroke hydraulic ram, it can be quickly and conveniently set at any of several points between 19 and 26 inches.

The drive train uses a variable-ratio torque converter with movable flange pulleys, a two-stage gear reduction



Screw-driven ram exerts a 12.5-ton force to split a log against the outside wedge. Stroke is adjusted to fit log size. Speed is about equal to a hydraulic splitter's.

similar to that used in Gilson tillers, and a final sprocket drive protected by a shear pin.

Power-Bolt operates with a splitting force of up to 12½ tons. But the unusual non-hydraulic force system is designed to sense the resistance of the splitting load and automatically adjust the force to match it.

Model 57001 uses a five-hp Briggs & Stratton engine, lists at \$830. Model 57000, with a five-hp engine plus roller-bearing road wheels and highway lights for trailering, is \$950. Gilson, Box 152, Plymouth, Wis. 53073.—
Mark Lindsley



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Diesel mini-trucks

go even farther on a gallon

By JIM DUNNE

PHOTOGRAPHS BY JOHN KEATING

If you need a small truck for commercial purposes, these new diesel models look like an exciting alternative. The savings in fuel costs can be substantial and easily offset their additional

initial cost in a short period of service. Or if you'd prefer a small pickup for personal transportation, especially for sporting weekends when you're driving a relatively long distance, the diesels can be effective money-savers.

We tested three new models: Datsun King Cab, Volkswagen LX, and

Continued

PS ratings— test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

	Datsun King Cab	Toyota	Volkswagen LX
Acceleration	0	0	0
Braking	2	1	2
Handling	3	2	4
Maneuverability	4	5	5
Quietness	0	0	0
Roominess	5	4	3
Vision	5	5	5
Entry/exit ease	5	5	5
EPA economy	5	5	5
Ride comfort*	2	1	3

*Author's opinion



High-mileage cargo carriers (from foreground) Toyota, Datsun King Cab, and Volkswagen LX — all equipped with four-cylinder diesel engines.

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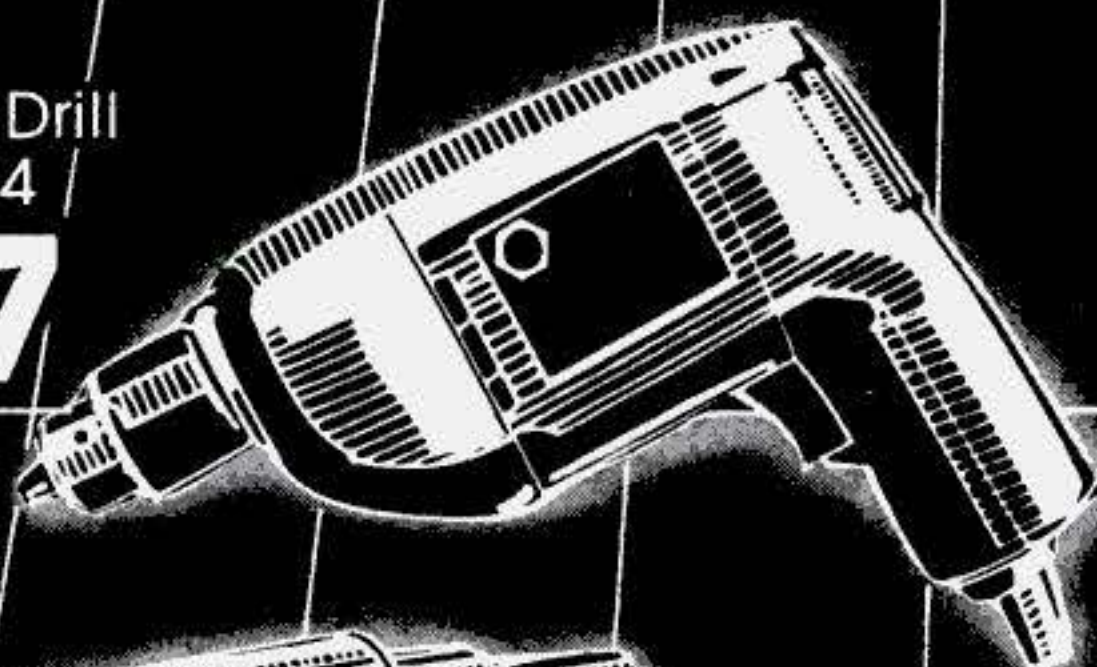
ments, with a side handle grip for better control. **\$36.97**. The **5 1/2-Inch Circular Saw** is an easy-to-handle lightweight that features bevel and depth-of-cut adjustments. **\$20.97**. The **Table Top Workmate** can be mounted almost anywhere for a stable work surface that tilts to 15-, 30- and 45-degree positions. **\$29.88**.

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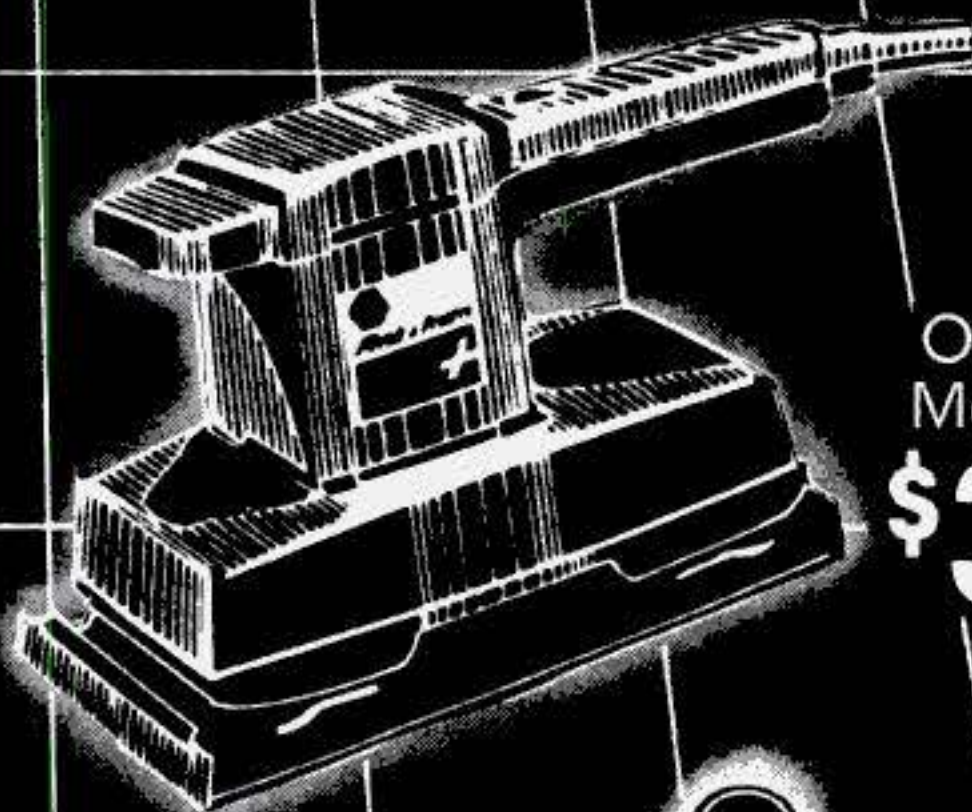
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Model No. 7104

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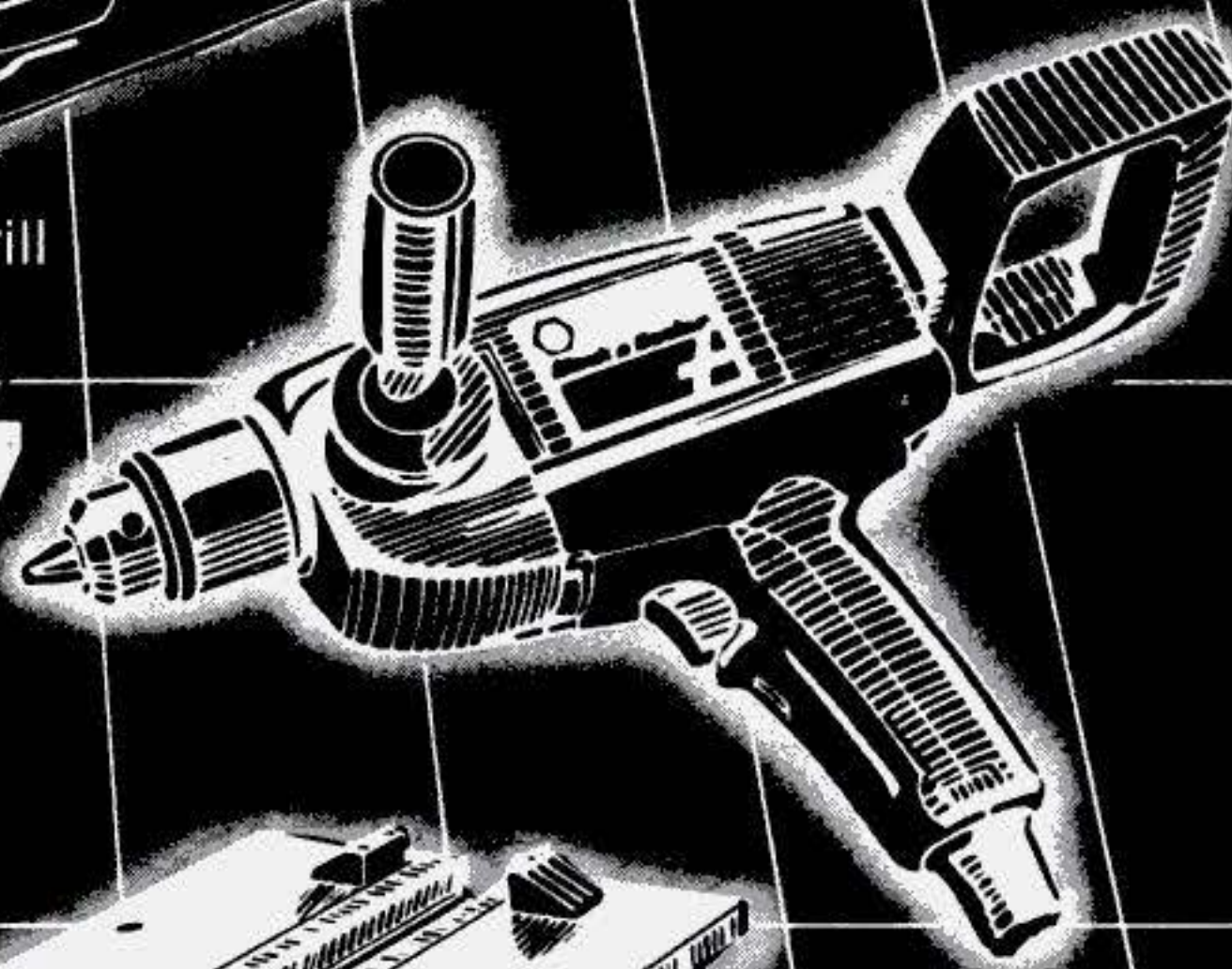
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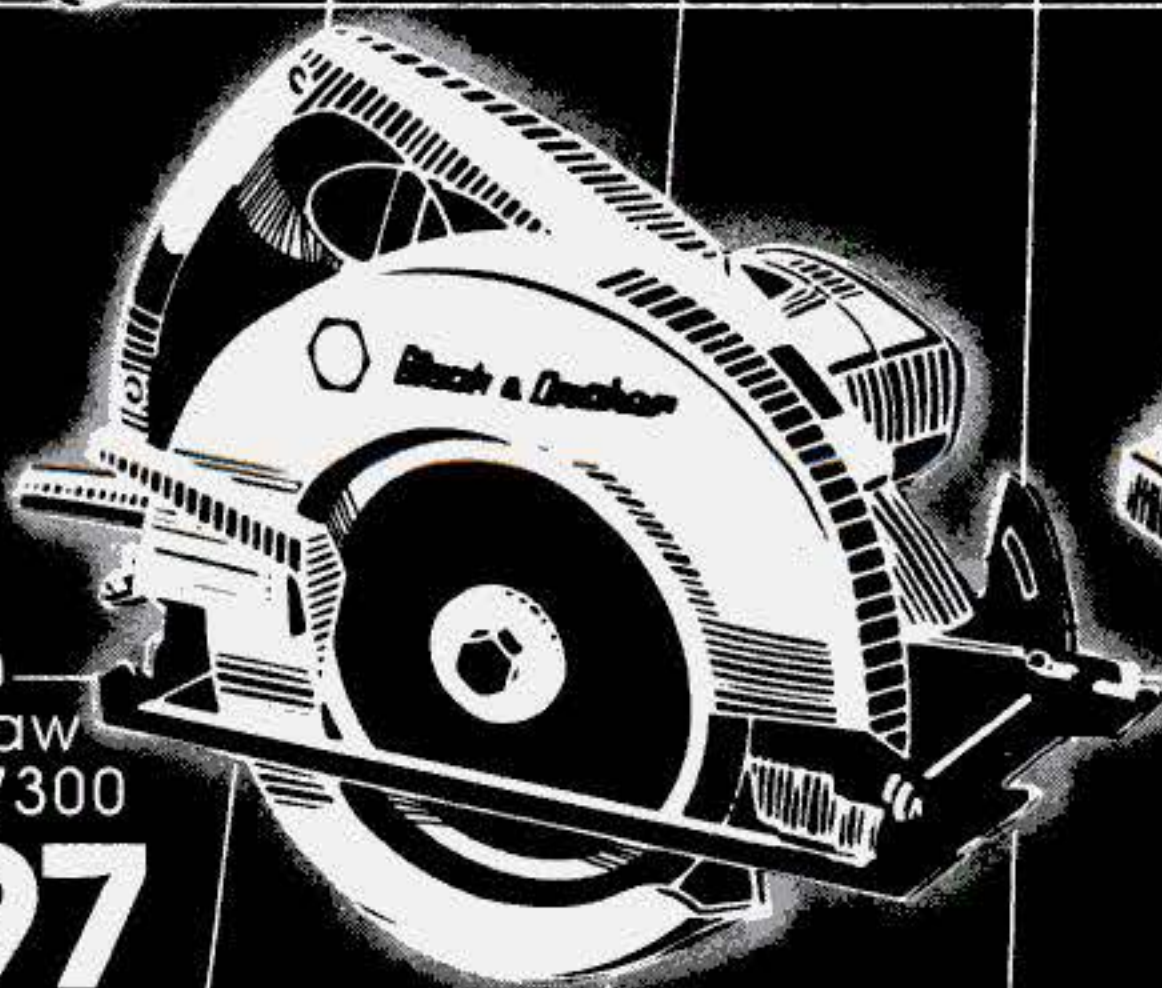
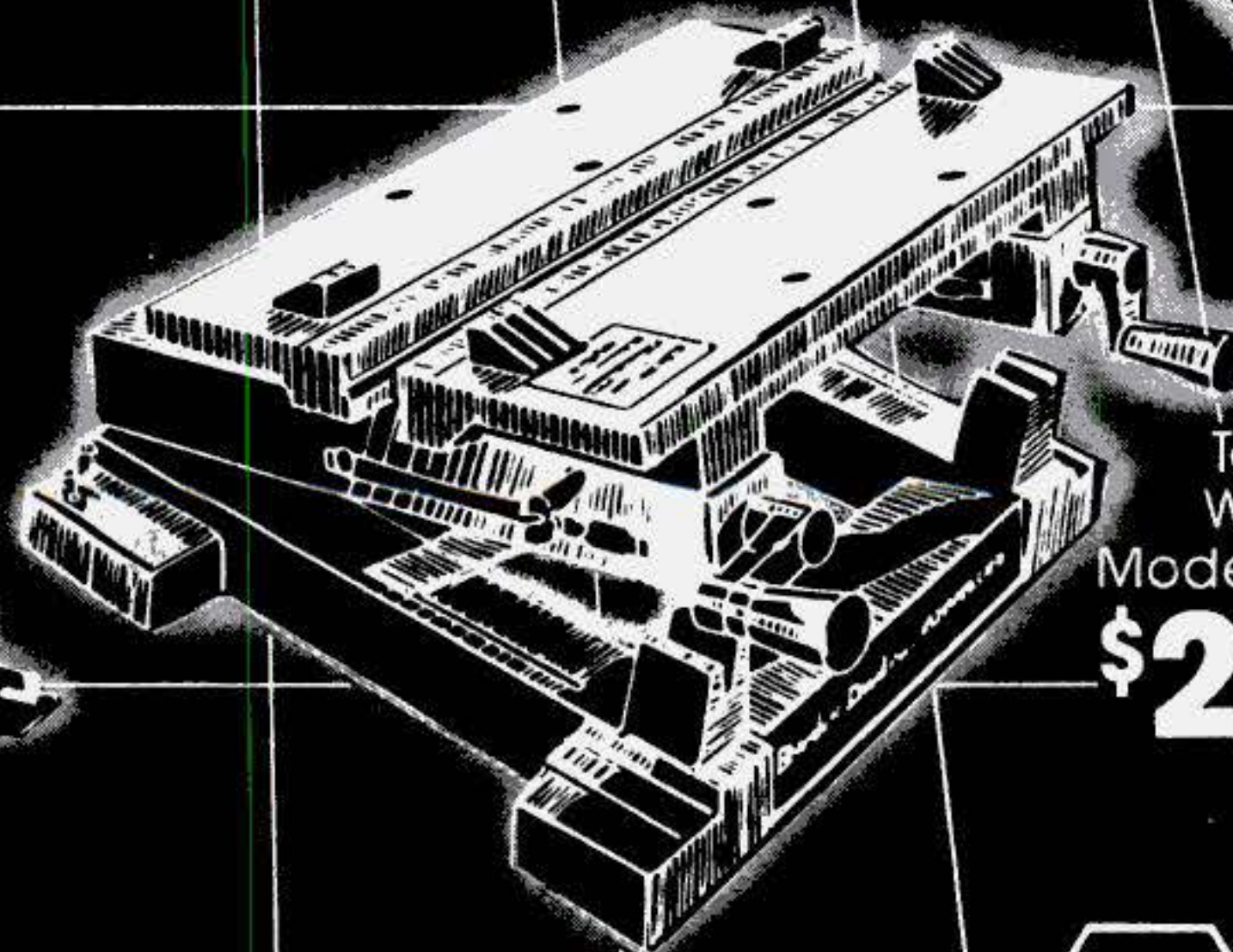


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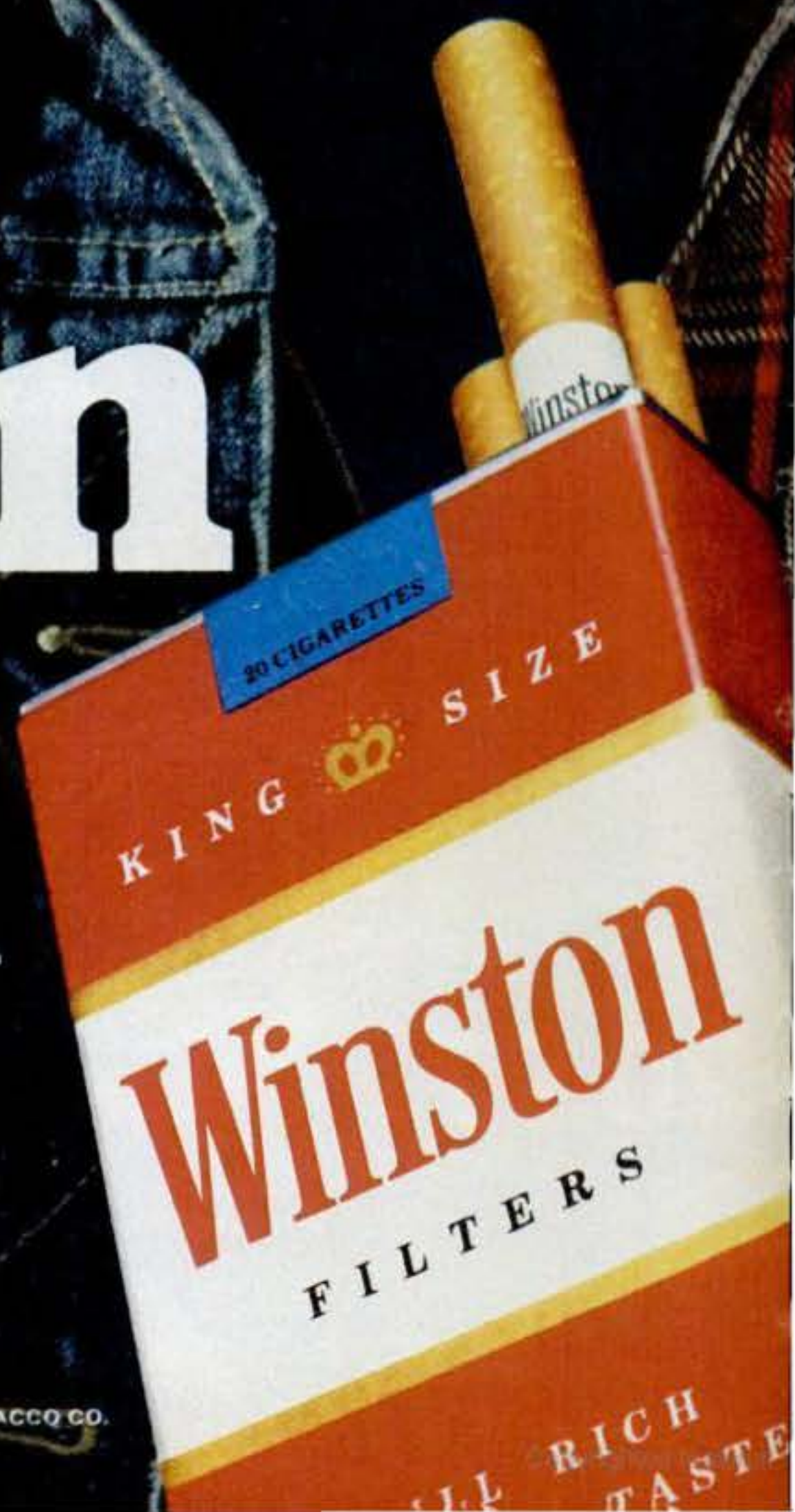
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PS brake test: 60-mph stop with cold brakes is followed by 10 warm-up stops before a final test with hot brakes. Fifth

wheel measures stopping distance, feeding to an on-board computer. VW LX pickup stopped in 177 feet with hot brakes.

Toyota—each equipped with a four-cylinder diesel and five-speed manual transmission, the most fuel-efficient power-train combination available. Our overall impression: Diesel engines in small pickup trucks make sense—so much so, in fact, that these three are undoubtedly only the first of a new generation of such vehicles. (Two more, which we weren't able to obtain in time for our tests but which should be available by the time you read this, are the Chevy LUV and a 4-by-4 from Isuzu.)

High marks

While the trucks' fuel economy is their foremost feature, we also gave them high marks for their compact size, easy maneuverability, roominess, and comfort features. It is also interesting to note the compact trucks' contrasting designs, including front- and rear-wheel drive and unit-body and frame-and-body construction.

Here's what we found in a check of

fuel economy. In 35- and 55-mph steady-speed tests Volkswagen came out as the economy champ. That's no surprise when you consider the lighter weight of this pickup and its much smaller engine. At a steady 35 mph in fifth gear, the VW truck recorded an exceptional 57.6 mpg. At a steady 55 mph the average dropped to 39 mpg. This second test is comparable to driving on a level freeway at legal speeds with no cargo aboard. While not as impressive as Volkswagen, Datsun, with 43 mpg in the 35-mph run, and Toyota, with 45 and 26 mpg, deliver considerably better mileage than their gasoline-powered counterparts. (Compare the city-driving mileages in the performance-comparison table.)

Diesel fuel costs less, and that adds up to savings, too. In spot checks we found that the difference between unleaded and diesel fuel can range from two to 10 cents a gallon. So in one tankful you can get an extra gallon free, compared with gasoline. (For

other diesel cost estimates see Detroit Report, this issue.)

Diesel drawbacks

But it's not all a plus. Diesels have drawbacks, too:

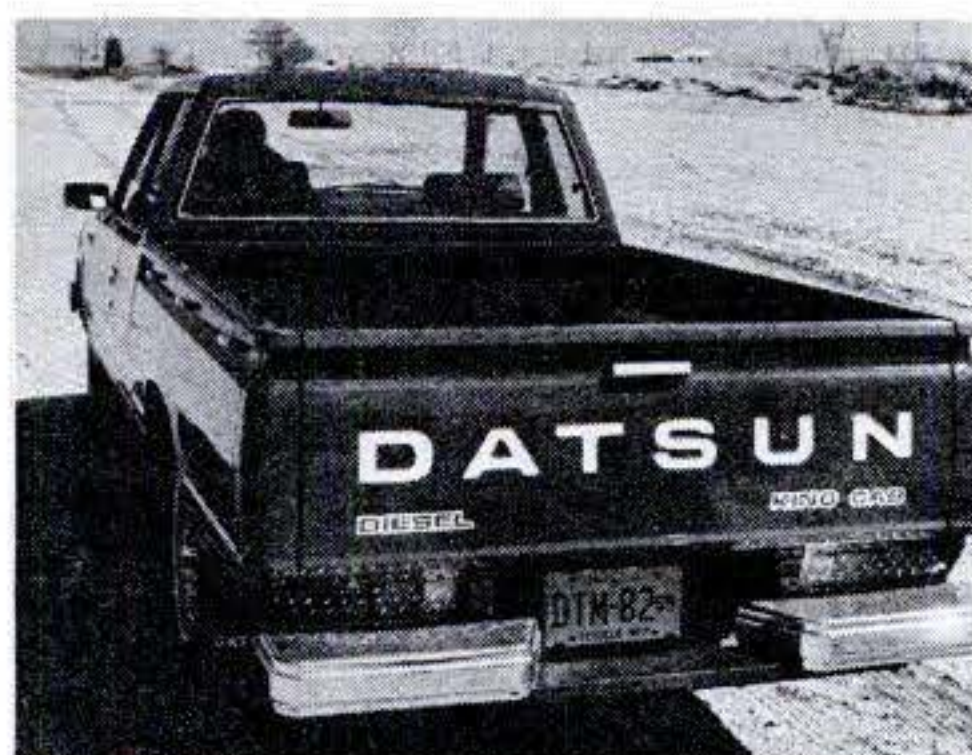
Diesels are noisy. That's true. But the four-cylinder engines are not as bothersome as bigger ones. In fact, at speeds over 40 mph the noise of these diesels is virtually indistinguishable from that of a gasoline engine. When parked with the engine running at idle, the noise is more noticeable but still not distracting. Put it this way: If you park a diesel in the driveway, your neighbors will note your coming and going without having to look out the window.

Diesels are slow. Are they ever! Our zero-to-60-mph times range from a leisurely 24 seconds (Datsun) to a dismal 32 seconds (Toyota). VW came in at 27 seconds. And there was not sufficient straightaway distance at our test track to even perform our standard 25-to-70-mph test. More important, the times were recorded when the trucks were empty. With a fully rated load they will be significantly slower. As a result, drivers must anticipate traffic conditions carefully when starting from a stop. Once under way the diesels will cruise easily at highway speeds. In hilly country, though, expect to downshift plenty in order to maintain speeds.

Diesels smell. Not so much as you might think. The exhaust from these small engines is less noticeable than that of big truck or car engines, almost not enough to talk about. In any event, we think it's a trivial problem if it exists at all.

Diesels are slow starters. The delay in getting a diesel cranked up on cold winter mornings can be irritating. But once the engine is warmed up, it usually restarts without any delay. At freezing temperatures, here's how long it took glow plugs to warm up the engine enough to fire on the pickups we tested: Volkswagen, 33 seconds;

Continued



As on most pickups, brands are spelled out boldly on the tailgates. VW, at 22 inches, had the lowest liftover height of the three.

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PS car test & driving report



Injectors of Datsun's 132-cu.-in. four-cylinder in-line diesel engine are easily accessible under the hood. All three trucks got high marks for serviceability.

Datsun, 41 seconds; Toyota, less than 15 seconds. (Toyota was the only pickup in our test equipped with two batteries; this may have had something to do with its relatively shorter warm-up time.)

In our opinion the major drawback of these mini-trucks is their lack of power. In fact if you carry 1,000-pound loads often, the diesel may not be husky enough to perform satisfactorily. Note that the "half-ton" classification of these vehicles is a nominal figure. The Toyota, for example, has a 1,300-pound payload rating. But this figure shrinks when a passenger is taken aboard or when such heavy-weight extras as air conditioning are installed. For instance, an air-conditioned Toyota would lose 50 pounds or so in payload capacity; add a passenger to the cab and the payload could go down another 150 pounds. The same is true of VW and Datsun. In small trucks a minor change in equipment can have a major effect on carrying capacity. (We show two cargo capacities in the spec charts: the pickups' empty ratings and their ratings with a driver and passenger aboard.)

In virtually all other respects the diesel pickups are identical to their gasoline counterparts. The exceptions

are in trailer-towing capacity and total-load capacity, which are limited because of the diesel engine.

Rabbit's difference

While Toyota and Datsun build similar trucks, the Volkswagen is different in a number of important ways. It's smaller and has a smaller engine. That is part of the reason for its better fuel economy. VW actually uses the Rabbit drive train and front end—from the doors forward—in its pickup. From the cab rearward, though, the Volkswagen pickup is unique. The construction is unitized, which means there is no underlying frame. Instead, body panels form much of the support for the chassis.

The VW's front-drive layout is unique among trucks sold in America. Its advantages include better traction, a steadier feel in the steering wheel, and a lower load platform. VW benefits from the use of the already proved Rabbit drive system, which is used intact in the pickup.

A double-walled cargo box just like those in the larger domestic pickups is a VW exclusive. The inside wall takes the punishment and bumps of shifting loads, protecting the outside sheet metal from unsightly damage. Note also that the VW has a five-inch-lower liftover height at the tailgate, a feature that makes loading of heavy cargo easier.

The Toyota diesel pickup truck is identical to its popular gasoline-powered counterpart except for the engine. It has more room in the cab than the Volkswagen and looks and feels more truck-like inside. The two-passenger bench seat folds forward to provide easy access to a tiny storage space in the rear of the cab. We found that the Toyota's heating system needs fine tuning if you want to get a mixture of cold and warm air. Otherwise you get either very hot or very cold air.

Roomy inside

Datsun has the best passenger accommodations in its King Cab design. The interior is roomy, seats can lean back without hitting the rear wall, and the extra storage space is handy. The cab does cut about 12 inches from the length of the cargo box, but we feel the compromise is worthwhile for the added room inside. With jump seats you can carry extra passengers for short trips in a modicum of comfort.

In other respects the Datsun is much like the Toyota, especially in the

EPA fuel mileage (mpg)

	Datsun King Cab	Toyota	Volkswagen LX
Highway	41	39	51
City	33	31	38
Calif. city	n.a.	n.a.	38

PS fuel-mileage tests (steady-state mpg)

35 mph	43.3	44.7	57.6
55 mph	31.8	26.2	38.9

truck-like feel of its unassisted steering and extra-stiff suspension.

Each of the diesels is equipped with a choke-like primer lever that assists engine starting in cold weather. It's a minor inconvenience to pull the lever, but a welcome start-up aid.

The spare tires of all three mini-trucks are located under the rear of the bed. In Datsun and Toyota you use a hand crank to lower it for access; in VW you release a latch to lower the spare. We find the crank system to be slightly easier to use.

The tailgates of the Datsun and Volkswagen are easiest to operate; a single handle releases them, which means you can open them with one hand while you're holding something with the other. Toyota's is somewhat more inconvenient: Two latches, one on either side of the gate, must be released to open it.

Braking

With all pickups, braking an unloaded vehicle can cause problems. On the three we tested we noted that the rear wheels lock up quickly when the brakes are applied firmly. When that happens, you must either let up on the brakes—and lengthen the stopping distance—or continue braking and see the rear end swing around sideways. If heavy cargo is carried in the rear, the problem disappears. Rear-wheel lock-up is caused by the light load on the rear tires, while brake pressure is calibrated to the most extreme loading conditions. A dynamic brake-equalizing valve could solve the problem and should be standard on all trucks of this type. With the equalizer the rear brakes get less pressure in an unloaded truck; when loaded they get full pressure.

My choice: the Datsun. That King Cab is irresistible, and I like the simplicity of the front-engine-rear-drive system.

For specs and test results, turn page

IF YOUR VIDEO INVESTMENT IS SHOWING DIMINISHING RETURNS,

it could be dropouts. White dots and dashes that spell trouble for your video investment.

Before you blame your video deck, think about this.

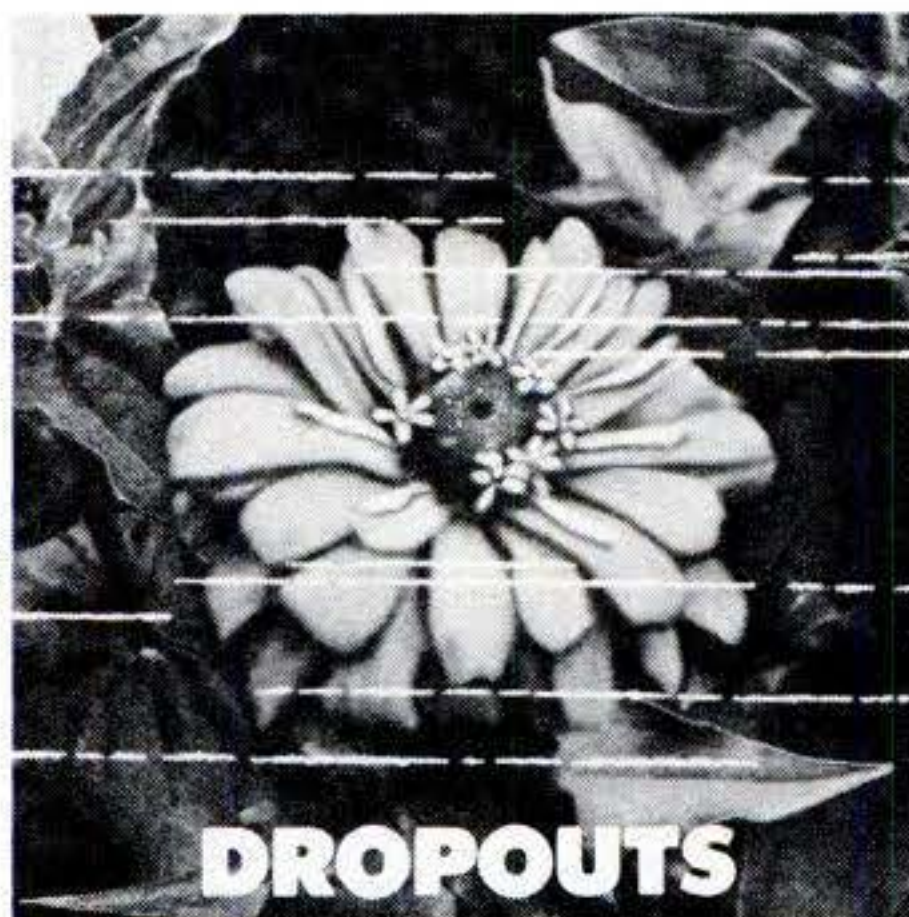
Tape passes over video heads that spin 30 times a

second. With the wrong tape, friction can cause oxide particles to shed, leaving you with dropouts and other video headaches.

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TDK's super precision mechanism keeps the tape running smoothly, with superb tape-to-head contact.

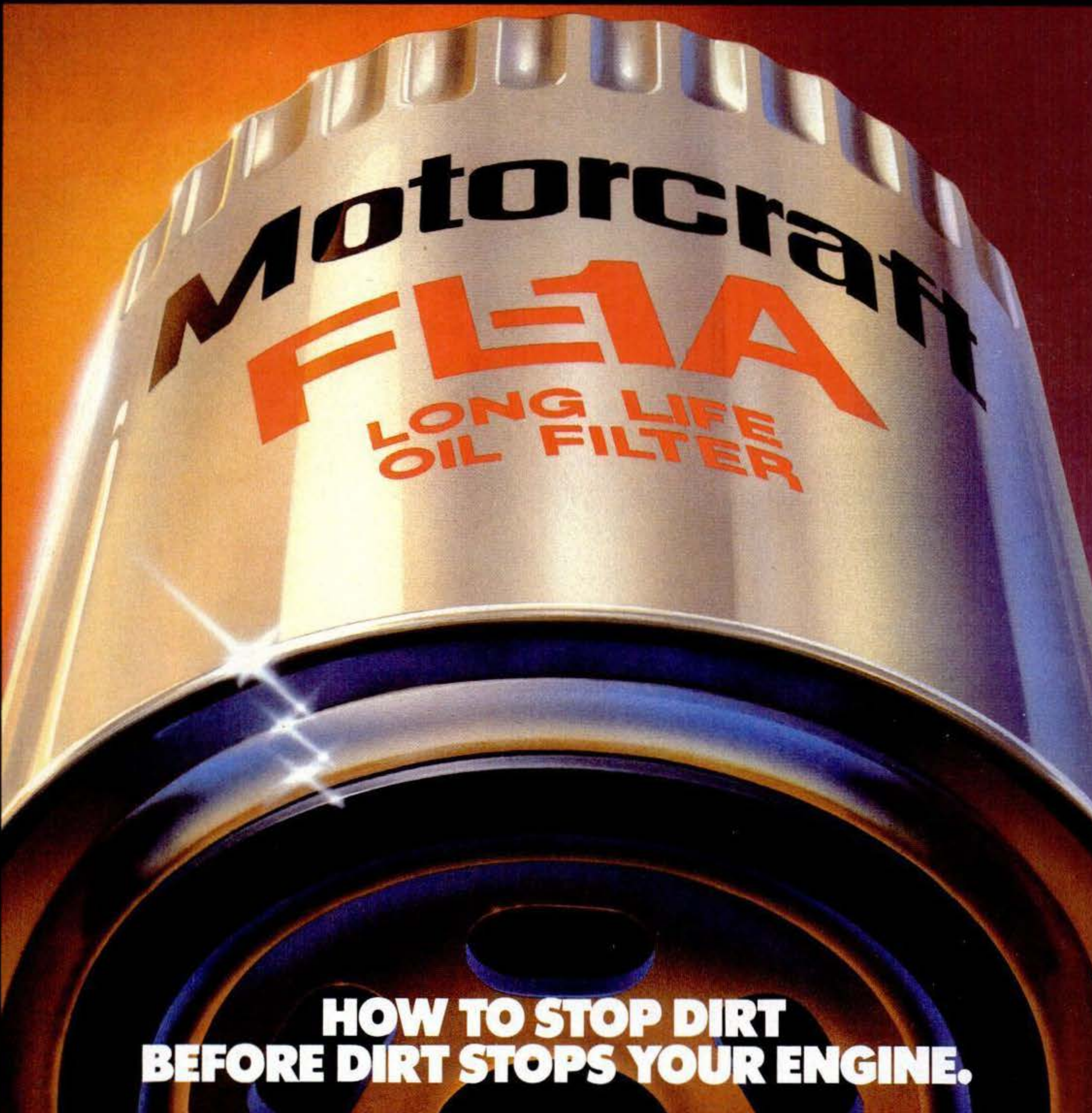
And Super Avilyn is remarkably compatible with just about any VCR you can buy. TDK supplies component parts, including video heads, to major VCR manufacturers. We know video inside and out.

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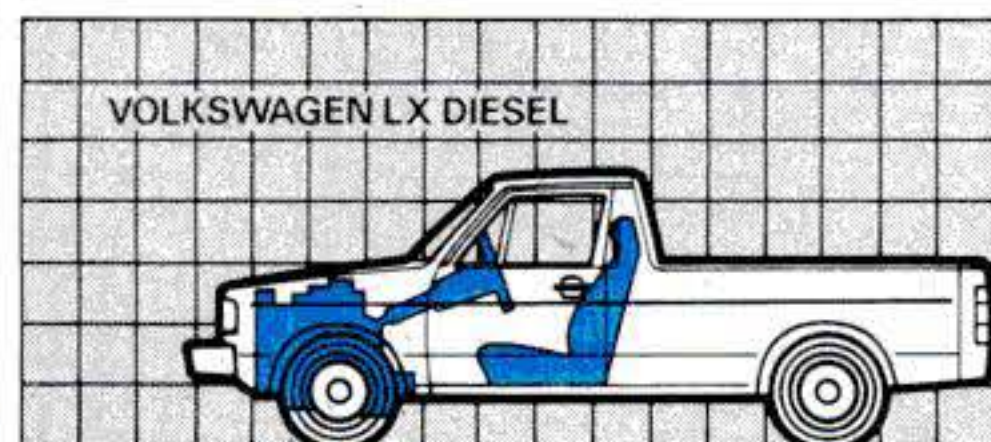
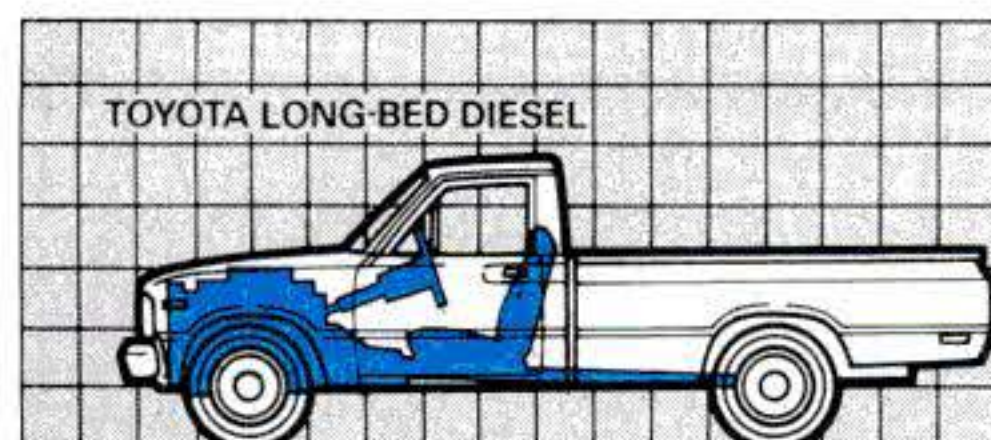
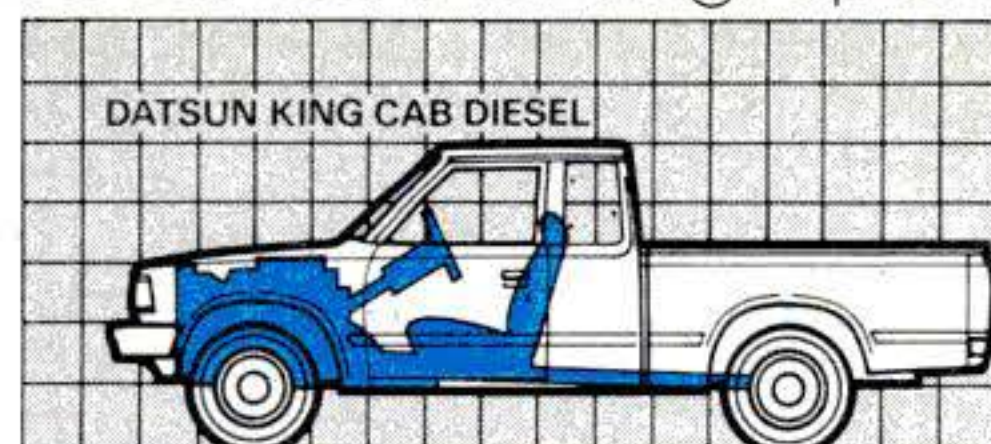


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The three trucks in this test are the first of a new breed of high-mileage cargo carriers. Size difference between VW and two Japanese imports is apparent in drawings at left. Rabbit derivative is 15½ inches shorter than Toyota, 17 inches shorter than Datsun. But note that VW's bed is only two inches shorter than Datsun's, owing to latter's larger cab. Toyota has the largest cargo box of the three.

Datsun King Cab, Toyota, and Volkswagen LX diesel mini-trucks—dimensions, specs, and test results

	Datsun King Cab	Toyota	Volkswagen LX
DIMENSIONS (inches)			
Wheelbase	110.8	110.2	103.3
Overall length	187	184.6	170
Overall height	61.2	58.9	54.6
Overall width	63.4	63.4	64.4
Track, F/R	52.2/50.8	53.5/51.1	53.3/54.1
Ground clearance	8	8	8
Front head room	36	36	37
Front hip room	44	44	46
Front leg room	44	42	41.5
SPECIFICATIONS			
Engine type	Diesel in-line 4	Diesel in-line 4	Diesel in-line 4
Displacement (cu. in./L)	132/2,164	134/2,188	97.1/1,588
Compression ratio	21.6:1	21.5:1	23:1
Carburetion	F.I.	F.I.	F.I.
Net hp @ rpm	61 @ 4,000	62 @ 4,200	52 @ 4,800
Net torque @ rpm	102 @ 1,800	93 @ 2,400	71.5 @ 3,000
Transmission	Five-speed manual	Five-speed manual	Five-speed manual
Axle ratio	3.89:1	3.9:1	3.89:1
Tire make	Bridgestone	Bridgestone	Michelin
Tire type	RD-113 steel	Skyway Deluxe	XZX
Tire size	185/SR14	E78-14	165/75R13
Steering	Recirculating ball, manual	Recirculating ball	Rack and pinion
Overall steering ratio	Variable 19.0-22.5:1	Variable 19.5-23.5:1	20.8:1
Turns, lock to lock	4.5	4.4	3.9
Turn diameter (ft.)	41	38.75	36.2
Front suspension	Torsion bar	Independent torsion bar, upper and lower control arms	Independent MacPherson struts, coil springs
Rear suspension	Leaf spring	Live axle, leaf springs	Tubular axle, leaf springs
Front stabilizer-bar diameter (in.)	0.83	n.a.	None
Rear stabilizer-bar diameter (in.)	None	None	None
Trailer towing (max. lbs.)	1,000	2,000	Not recommended
Trailer tongue weight (max. lbs.)	100	200	Not recommended
Brakes	Disc/drum	Disc/drum	Disc/drum
Brake swept area (sq. in.)	223	337.1	n.a.
Fuel tank (gal.)	13.2	16.1	15
Curb weight (lbs.)	2,570	2,770	2,046
Cargo capacity (payload)	1,400/1,100*	1,300/1,000*	1,103/803*
Bed length (in.)	74	86	72
Bed width (in.)	60	60	51.2
Bed height (in.)	15	16	15.7
Liftover height (in.)	27	27	22
F/R weight distribution (%)	n.a.	58.3/41.7	n.a.
Basic price	\$7,509	\$7,218	\$7,045
Price as tested	\$8,269	\$7,218	\$8,863
Major options (over \$100) on test car	A/C \$580, AM/FM stereo \$160	None	A/C \$585, LX package \$420, AM/FM stereo \$330, five-speed \$190, metallic paint \$105

TEST RESULTS

Acceleration (sec.)			
0-60 mph	23.8	32.3	26.9
25-70 mph	—	—	—
Brake test (cool) 60-0 mph			
Stopping distance (ft.)	194	180	168
Pedal pressure (lbs.)	110	60	40
Brake test (hot) 60-0 mph			
Stopping distance (ft.)	173	210	177
Pedal pressure (lbs.)	90	55	95
Interior noise @ 60 mph (dBA)	76	78	75
Handling test (mph)	60	58.2	62.4
Maneuverability test (mph)	26.8	27.9	33

TEST CONDITIONS: Ambient temperature, 35°F; relative humidity, 70 percent; barometric pressure, 29.9 inches Hg

*With driver and passenger

PS serviceability ratings

How easy is it to service our test cars? For example, is that heater hose clamp out in the open where it can be reached easily? To give you an approximation of how difficult it is for a typical person to perform various service operations on the cars, we examine each vehicle. Here's what the numbers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty, no worse or better than most other cars; 4, easy; 5, very easy.

	Datsun King Cab	Toyota	VW LX
Checking fluid levels			
Battery	5	5	5
Master cylinder	5	5	5
Windshield washer	5	5	5
Engine oil	4	5	3
Coolant	5	5	5
Checking the engine			
Spark plugs	—	—	—
Distributor	—	—	—
Carb adjustment	—	—	—
Oil filter	4	5	3
Oil fill	3	5	3
Replacing hoses			
Upper radiator hose	5	5	5
Lower radiator hose	2	3	4
Heater hoses	4	4	3
Changing bulbs			
Headlights	3	3	3
Taillights	4	4	4
Front running lights	3	3	3
Front parking lights	2	2	2
Front directionals	2	2	2
Rear directionals	4	4	4
Rear running lights	4	4	4
Checking fuses			
Spare-tire accessibility	5	5	4
Changing belts	5	5	3

Performance comparison with selected 1980 and 1979 models

	Mpg (city driving)	Acceleration 0-60 mph (sec.)	Brakes 60-0 mph (hot) (ft.)	Handling (mph)	Maneuverability (mph)	Noise @ 60 mph (dBA)
1980 Volkswagen (gas)	23	15.8	152	58.2	27.6	79
1980 Datsun King Cab (gas)	25	15.8	200	54.5	27.2	74
1979 Chevy LUV	22	20	174	56.3	25.7	74
1979 Ford Courier	22	14.5	170	58.2	28.6	76
1979 Datsun King Cab	21	14.3	160	58.2	27.6	77
1979 Plymouth Arrow	21	12.3	167	60	28.6	72
1979 Mazda	27	15.4	168	54.5	25	76
1979 Subaru Brat	25	19.6	180	60	30.1	73
1979 Toyota Long Bed SR5	18	14.2	168	58.2	28.6	72

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LOOK AND LISTEN

By JOHN FREE



Matsushita VCR/camera

Another ultracompact VCR/camera combination has been shown in Japan by Matsushita, parent company of Panasonic and Quasar here. The prototype machine (above) is smaller (nine by 4.7 by 2.6 inches) than a Hitachi machine with two-hour record/playback capability shown earlier ["Look and Listen," May]. Major VCR firms in Japan have been unveiling prototypes of single-piece VCR/cameras, vying to establish their tape formats as standard. Last year Sony showed a VCR/camera with a half-hour capability [PS, Nov. '80], but suggested 1984 would be the earliest date for marketing. Hitachi is aiming at a 1982 introduction date.

Matsushita's so-called micro-video system uses cassettes about the size of ordinary compact audio cassettes. Both it and Hitachi's similar cassette can capture two hours on a new metal-alloy videotape. Sony opted for a metal microcassette in its prototype that records only 30 minutes. Hitachi's so-called MAG system has the circuits for producing an RF signal for the TV receiver built into it. Matsushita decided to put the playback circuit and RF converter inside an adapter that also functions as an AC/DC converter and battery charger.

Also, the company decided to use a tiny

1/2-inch vacuum pickup tube in the camera. Matsushita may later switch to a solid-state camera sensor, used in the Sony and Hitachi prototypes. The micro-video recorder/camera weighs just 4.6 pounds with a battery. New microcircuits have reduced power consumption to five watts, 30 percent less than hardware from its potential competitors, says Matsushita.

CBS pushes hi-fi TV

"What we're trying to show here is that the future for high-definition [H-D] TV is a lot closer than most people think," said Joseph Flaherty, CBS's chief broadcast engineer. Flaherty, at CBS's Washington, D.C., offices, presided over an amazing demonstration I saw that contrasted today's 525-line U.S. color-TV system with a 1,125-line super-fidelity system under development by NHK in Japan. Other H-D TV features: a wide-screen picture-aspect ratio of 5:3 compared with the almost-square 4:3 ratio in use; enhanced color fidelity; and stereo sound.

A 1,125-line NHK color-TV camera displayed incredibly sharp, detailed views of studio pictures and traffic on the street below. Images were projected from a special Panasonic H-D two-piece TV. Next to this projection TV was a somewhat larger conventional projection TV with a six-foot

screen showing the same scenes with a 525-line camera.

While the 525-line images were the best available, they seemed fuzzy compared with H-D TV pictures. I could easily read lettering on a truck in the street with the 1,125-line screen; it was a blur on the 525-line system. Looking closely at the H-D TV pictures, it was impossible to see scanning lines—images were visually identical to razor-sharp projected transparencies.

Color-TV cameras were needed because at the time of the demonstration a videotape recorder was not available with the 30-MHz bandwidth required (the frequency spectrum of five 525-line TV channels). Sony has since announced its own complete H-D TV system, including a 30-MHz recorder. Still more bandwidth is needed with digitized video signals.

Sony and CBS demonstrated a new digital video recorder and data-compression techniques that "squeezed" the 114 million bits per second (megabits/sec.) of digital information required for a digitized 525-line signal into only 28 megabits/sec. Flaherty indicated that complex, low-cost microcircuits used for computers could make H-D TV broadcasts practical. "The same explosion of microelectronics will bring about H-D TV within this decade," he said, suggesting that microcircuits in home TV sets could expand digitally compressed H-D signals for viewing.

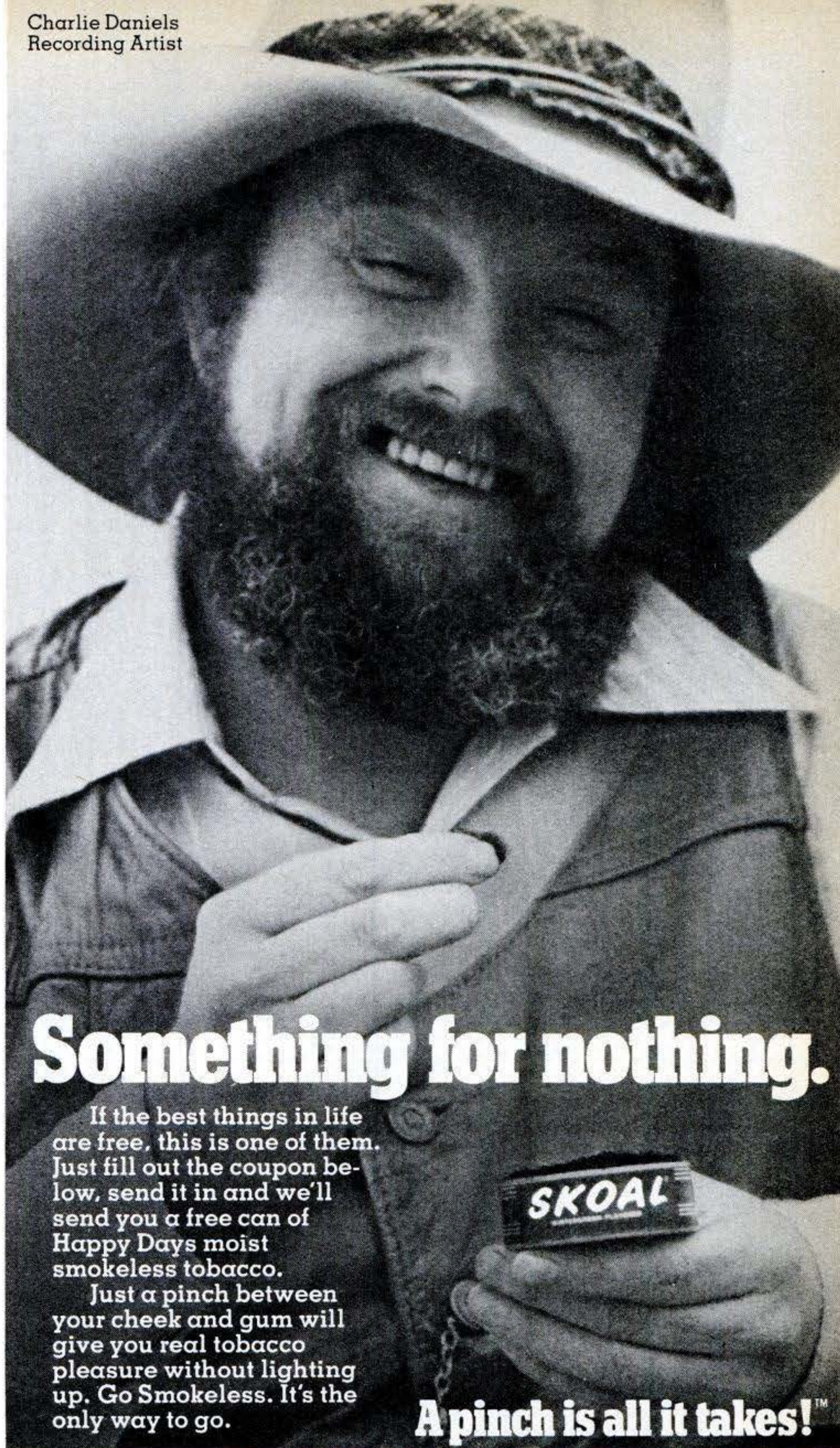
CBS wants to ensure that spectrum space is reserved for H-D TV later in the decade if satellites begin broadcasting directly to homes [PS, March '78]. Comsat has proposed such a direct-broadcast-satellite system. CBS wants to be in a position to compete when H-D TV is released on special videodiscs and VCR tapes or carried on cable TV.

Quick looks

- Times Mirror, parent company of Times Mirror Magazines (which includes Popular Science), is readying a test involving some 200 terminals around Los Angeles that can pick up text information sent through phone and cable-TV lines for display on television receivers. Time Inc., another major publisher, is planning an electronic magazine experiment involving a satellite to transmit text to cable-TV companies. Also, Zenith and Chicago publisher Field Enterprises are field-testing 110 receivers with decoders that display text broadcast on unused TV-scan lines.

- If you dislike flipping records over to play the second side, the computer-controlled, linear-tracking turntable Sharp is introducing may help. The vertically mounted turntable, part of the VZ-3000 music system (speakers, tuner, amps, cassette deck), has two tone arms to play both disc sides. For photo, see p. 84.

- Sony is introducing a line of so-called Profeel color-TV monitors into the consumer market. Tunerless monitors are used largely by professionals to view picture quality. Sony will market plug-in tuners, and Profeels have other jacks for video output signals from VCR's, videodiscs, or TV games. The largest, 26-inch monitor has special picture-enhancement circuits, and may cost about \$1,500 complete. [PS]



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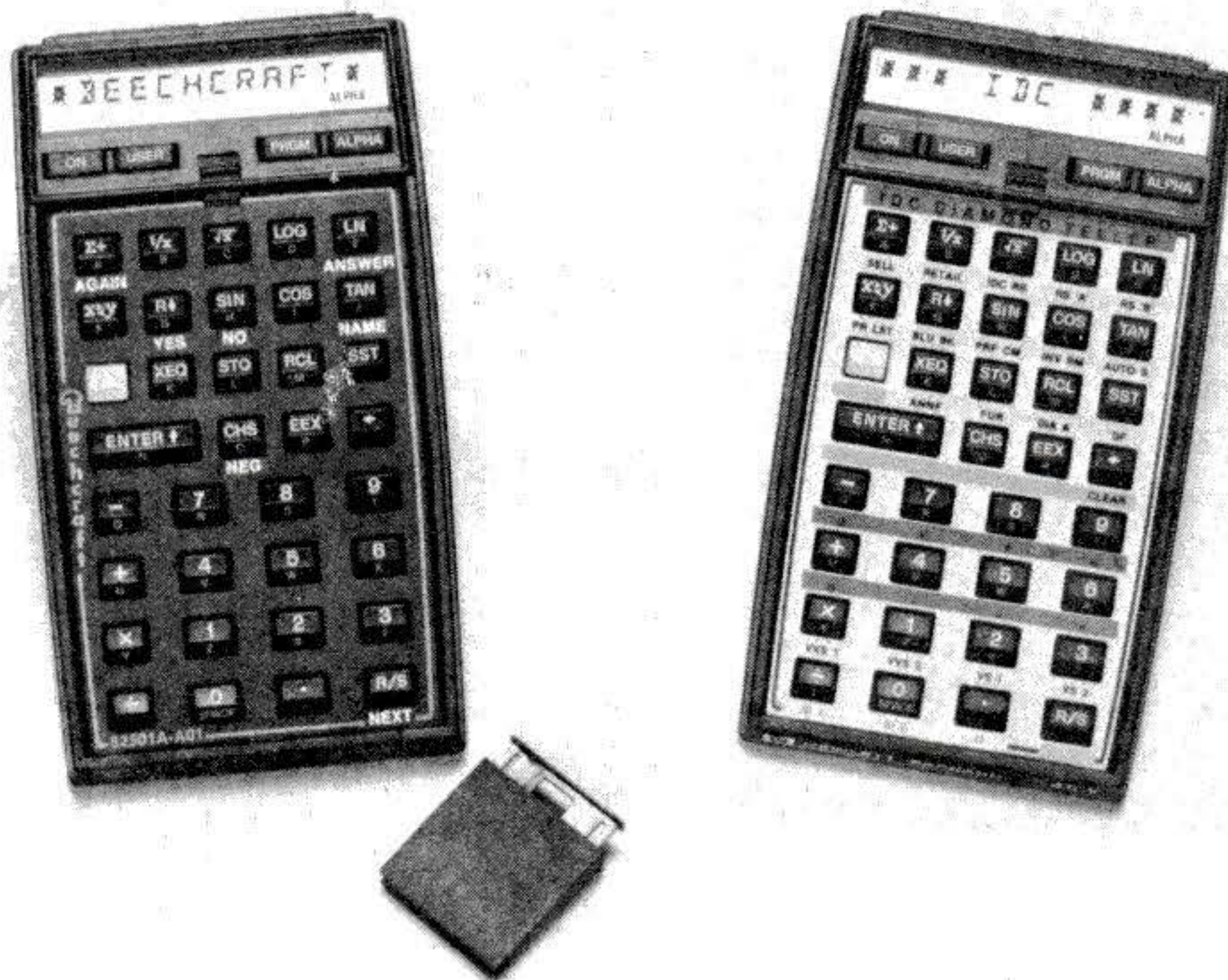
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PS 102

CALCU-LETTER

By **DARRELL HUFF** News of pocket calculators—and how to have fun with them



CALCU-PUZZLES

Short loan

The last "Calcu-letter" offered a choice of routines to find the monthly payment of a 10-percent, 30-year, \$20,000 mortgage. You were asked how many monthly payments of that size would be needed if the loan was reduced by \$5,000.

You may have been surprised to discover that reducing the loan amount by one-fourth slashed the payoff period by considerably more than half. Your monthly \$175.51 would amortize the \$15,000 loan in just over 12½ years.

You could reach this solution from the given formula by iteration, or you could transpose the formula. A few algebraic steps would bring you to a statement that:

$$1^{-n} = 1 - \frac{p \cdot i}{a}$$

where i = periodic interest rate as a decimal; $l = i + 1$; n = number of payments; a = amount of payment; and p = principal amount of the loan.

To this equation, apply the third rule of logarithms, which says that the log of a power is equal to the exponent times the log of the basis. You thus find the number of payments when you divide the log of the right side of the equation by the log of 1 plus the periodic rate, then change the

sign. Result: 150 months plus a few days.

Long shots

Of four states conducting lotteries that draw numbers from 0 to 999, there are three combinations that produce two pairs—for a total probability of 0.000002997. A triple match can occur four ways for a probability of 0.000003996. Four of a kind: That's one in a billion.

Pregnant figures

The chance of a perfectly fertile couple achieving pregnancy in one month is 20 percent if they're in their 20's but only eight percent if in their late 30's, say researchers in Belgium. What are their odds for conceiving over the course of a year? What about five years?

Grandpa's gate

An Ocean, N.J., reader signing himself Grandpa Gordon thinks you might enjoy a practical problem he encountered in building a gate. For its convex-curved top, he wanted to cut the largest possible segment of a circle from a board eight inches wide and 30 inches long. What is the radius of the circle? Answers to both problems will be in the next "Calculetter."

Made to order

Not long ago, calculator software came as printed programs that you had to enter manually, stroke by stroke. Then instant programs—on plastic strips, or as bar codes entered by electronic wand, or as tiny plug-in modules carrying dozens of elaborate programs—became available. The newest trend is customized calculators that meet the specialized needs of a single business or small group.

Texas Instruments will design and produce solid-state software to order—"at a very low cost," the company says. And now Hewlett-Packard makes its bid with the custom packages shown here: one for pilots of the Beechcraft Super King Air jet prop (left), and one that analyzes investments for salesmen of International Diamond Corp. (right). The made-to-order packages include a plug-in module and matching keyboard overlay for the H-P 41 CV. The 41 CV, H-P's newest model, has five times the memory of the 41 C—up to 2,000 program lines—and lists for \$325. Owners of the 41 C can use the custom programs if they obtain an \$85 plug-in memory module.

Polish, anyone?

The 41 CV, like all H-P models, uses Reverse Polish logic (RPN). What is Reverse Polish, and how does it differ from other logic? A simple problem illustrates the difference: $2 + 3 \times 4 = ?$

Most calculators will assume you want the operations performed in the order given, and will answer 20. That's wrong: The rules of math say you must multiply or divide before adding or subtracting.

AOS (Algebraic Operating System) calculators—including all TI models—get the right answer by rearranging the problem internally. If you want the addition performed first, you must use parentheses.

With RPN, you enter the numbers, then push either plus and times or times and plus; it makes no difference. To do the addition first, the sequence is: 2, ENTER, 3, +, 4, $\times$. A Reverse Polish calculator has no equals key or parentheses.

What's Polish about it? That's in honor of the genius of math and logic who originated the system, Jan Lukaszewicz. There's an article about him and his logic in the 1980 edition of H-P's *Personal Calculator Digest*—free to PS readers (Hewlett-Packard, 100 N.E. Circle Blvd., Corvallis, Ore. 97330).

Calc clubs

Here's a footnote on the friendly rivalry between partisans of AOS and RPN logic (see "Calcu-letter," PS, Sept. '80 and Jan. '81, for addresses of clubs). A recent issue of *PPC Calculator Journal* tossed a challenge to members of the TI Personal Calculator Club: "Compute the first 1,000 decimal digits of pi in less than 11 hours, 30 minutes. Care to join the fray?"

By the way, users of the FX-501P and 502P need not feel left out. You can get information about the Casio Calculator Club from Kiyoshi Akima (2880 20th St., Boulder, Colo. 80302).

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NEW LUV DIESEL HAS IT ALL

Terrific news. There's a new LUV. It's a diesel, and it's available in all LUV models. 2- and 4-wheel drive. So you get all the popular LUV features. Plus some new ones. Like LUV Diesel's Quick-On system. Which means the engine is ready to start in just $3\frac{1}{2}$ seconds or less. And LUV Diesel has pep. With a hefty SAE net torque rating of 93 lb.-ft. at 2200 RPMs.

To top it all off, get a look at these 2WD diesel mileage estimates:

Diesel 2WD

44

EST. HWY.

32

EPA EST. MPG (CITY)

Unbeaten 4-wheel-drive mileage.

No pickup in America offers better 4WD mileage. Which means now you can get both four-wheel-drive traction, *and* sensational fuel economy.

Diesel 4WD

35

EST. HWY.

28

EPA EST. MPG (CITY)

Unbeaten payload and cargo box length.

LUV Diesel's 7½-ft. cargo box on the 2WD long wheelbase model is as long as you can get on any small-size pickup. And it has a whopping 1690-lb. payload capacity. Payload includes passengers, equipment and cargo.

Unbeaten driving range.

The new LUV Diesel's long wheelbase 2WD model's estimated driving range is 611 miles. Estimated highway range, 840 miles. You can't beat that in any small pickup.

Use estimated MPG for comparisons. Your mileage and range may differ depending on speed, distance, weather. Mileage and range will be less in heavy city traffic. Actual highway mileage and range lower. Range is obtained by multiplying the 19.1-gallon fuel tank capacity by the EPA estimates. Not available in California.

LUV engines are produced by Isuzu Motors Limited, Japan.



Built tough. Built for economy.



RECREATION ROUNDUP

By HERBERT SHULDINER



Van annex

This clever new tent adds an eight-by-eight-foot room to your van when you're camping. The versatile nylon unit comes with its own floor and has a screen in front. Besides being designed for use as a complete tent, it has sides that are removable so the canopy can be used alone, as shown on the van at left. All the setup poles are completely detachable, and no holes need be drilled in the van for erection of the tent. The tent and hardware can be carried in a 3½-ft.-by-seven-in.-dia. tote bag. The Vanroom II is made by A&E Systems, Inc., 3100 Segerstrom, Santa Ana, Calif. 92704. Price is \$440.

High roller

Camping trips into remote areas are limited in time by the amount of supplies you can carry. The Portager I is designed to lengthen such trips by letting you pack in lots of gear and supplies without having

to carry them on your back. The one-wheel carrier can be loaded with about 325 pounds of supplies, according to the maker, Creekside Wilderness Products (Box 6896, San Jose, Calif. 95150). Portager I is designed to be rolled along wilderness trails by two persons. The wheel is designed to pivot back when it hits an obstacle. It can also be pushed back so the cart lies flat for loading. The cart weighs just under 18 pounds and costs \$490.

Waist-high tackle box

Berkley's Fishin' Partner is a handy tackle box you can wear around the waist or suspended from the top of your waders. It leaves your hands free for fishing and also provides a small workbench. The box is made of molded plastic and has seven



compartments large enough to hold big lures. There's also room for a spool of line, tools, and even a sandwich. Price of the Fishin' Partner is under \$20. Made by Berkley and Co., Spirit Lake, Iowa 51360.

Handicapped boatmen

A new organization seeks to assist the 400,000 disabled boatmen in the U.S. The Handicapped Boaters Assn. is led by Gene Hedley, who has conducted research for the Coast Guard on the needs of disabled boatmen. More information on the HBA is available from Box 1134, Ansonia Station, New York, N.Y. 10023.

Outdoor-activity boom forecast

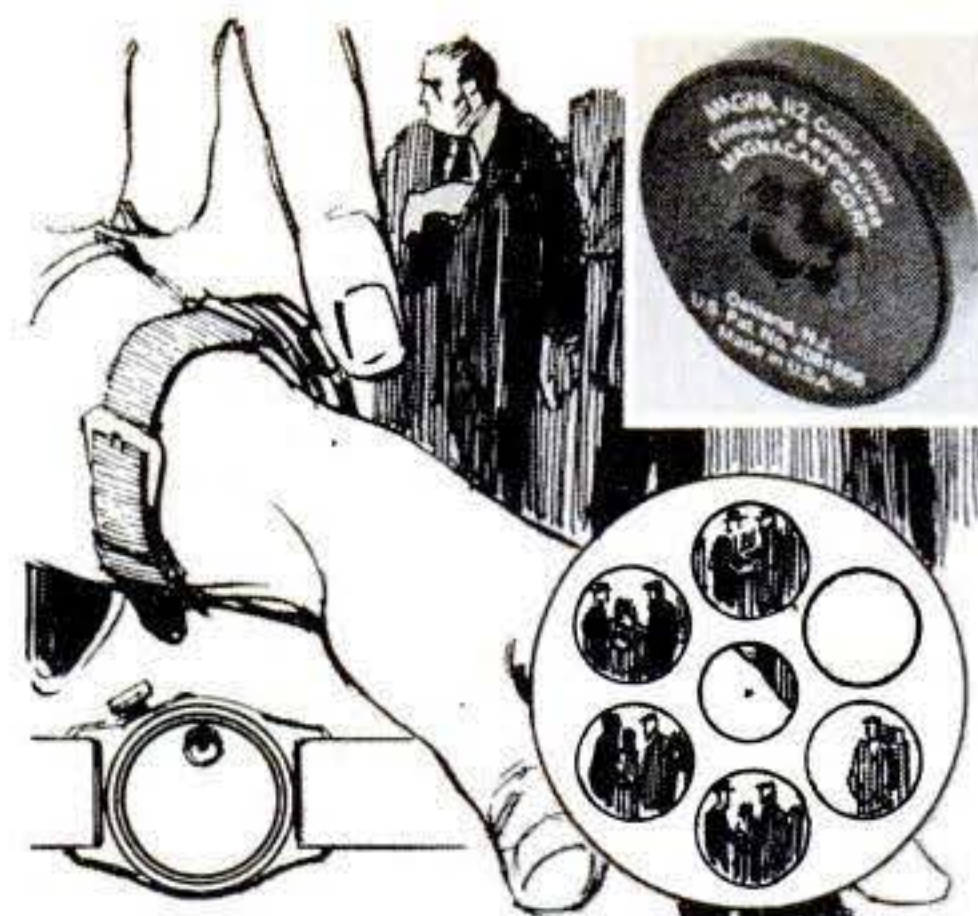
Frost & Sullivan, a noted market-research company, has released a new study that predicts camping-equipment sales will grow at "a double-digit annual pace through the middle of this decade." The company says cross-country skis will have the biggest growth (17.5 percent). Tent sales will grow by 14 percent, sleeping bags by 13, coolers by 9.5, backpacks by six, and mountaineering equipment by five percent. The company says that camping-equipment buyers are now older than in past years. The market is becoming more family-oriented, with fewer college-age customers.

RV chalet

Remember the leisure home PS presented back in October 1976, in which a motor home or travel trailer was used to provide the plumbing module for a vacation hide-away? Freemor Homes and Yellowstone travel trailers have now teamed up to sell this idea. The new Freemor Homes package uses a 22-foot Yellowstone YF-7 travel trailer, which provides the plumbing facilities. The permanent part of the structure contains a living room, dining room, bedroom,

and closets. It also has a rear sun deck. Besides the bathroom and galley, the trailer provides additional sleeping and living space. The cost of the permanent structure: \$24,000 to \$30,000. The trailer is \$9,700 f.o.b. Freemor Homes, Box 6424, Pittsburgh, Pa. 15212; Yellowstone, Box 1128, Elkhart, Ind. 46517. **E3**





Don't worry about lining up the horizon in the viewfinder—the picture this camera takes is round, and you can turn it any way you please to make the horizon horizontal.

That's just one advantage of the 3½-ounce Wristamatic, a tiny new camera that you can keep as handily close to you as your own wrist.

The ingenious camera, invented by Bernard Seckendorf, an accountant, first appeared in "New Ideas from the Inventors," *POPULAR SCIENCE*, October 1978 (drawing above). "Using a shutter operated by magnetic repulsion, this camera could be made small enough to be worn on the wrist," said our caption. It went on to describe the "round, flat cassette," which you would rotate "to expose, in turn, each of six tiny negatives."

All true. The cassette (inset, top right) consists of a plastic base plate, a disc of color-negative film, and two rotating covers, each with a 10-mm circular opening. When the openings coincide and the shutter (the camera's only moving part) is snapped, the film is exposed.

The cassette, called a Filmdisk, rotates like a record on a spindle. Processing is uncomplicated: Film can be lined up on a spindle for easy dunking, like slices of onion on a shish kebab spear. And the discs of film can be rotated on a spindle in an enlarger with a minimum of handling.

The Wristamatic has a 20-mm f/11 fixed-focus lens, with a range from five feet to infinity. It sells for \$39.95. Filmdisks come three to a package (18 exposures) for \$1.99; processing is \$5.70. That's \$7.69, or about 43 cents a print. You send the exposed film to Magnacam Corp. (which makes the camera and sells and processes the film). You get back round 100-mm (four-inch) prints.

Inventor Seckendorf, who is president of Magnacam Corp. (16 Muller Road, Oakland, N.J. 07436), says "it's hard to take a bad picture with the Wristamatic." We'll see.—*Everett H. Ortner*

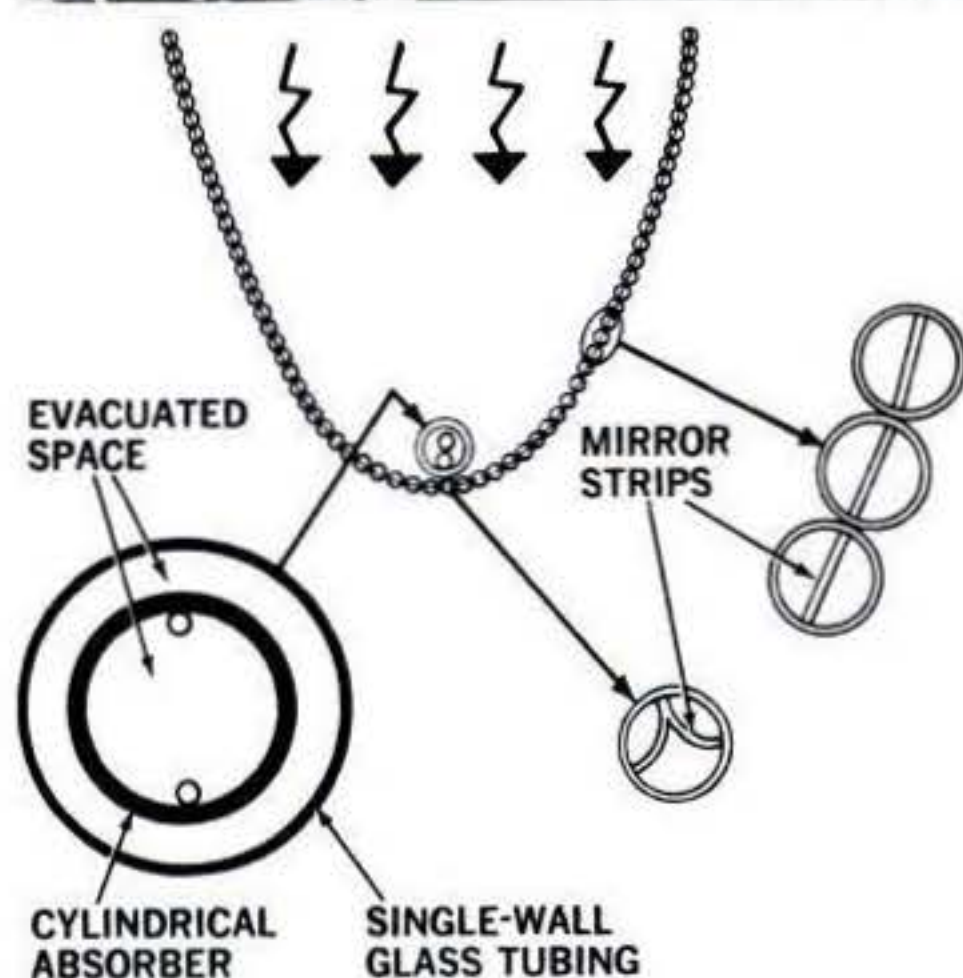
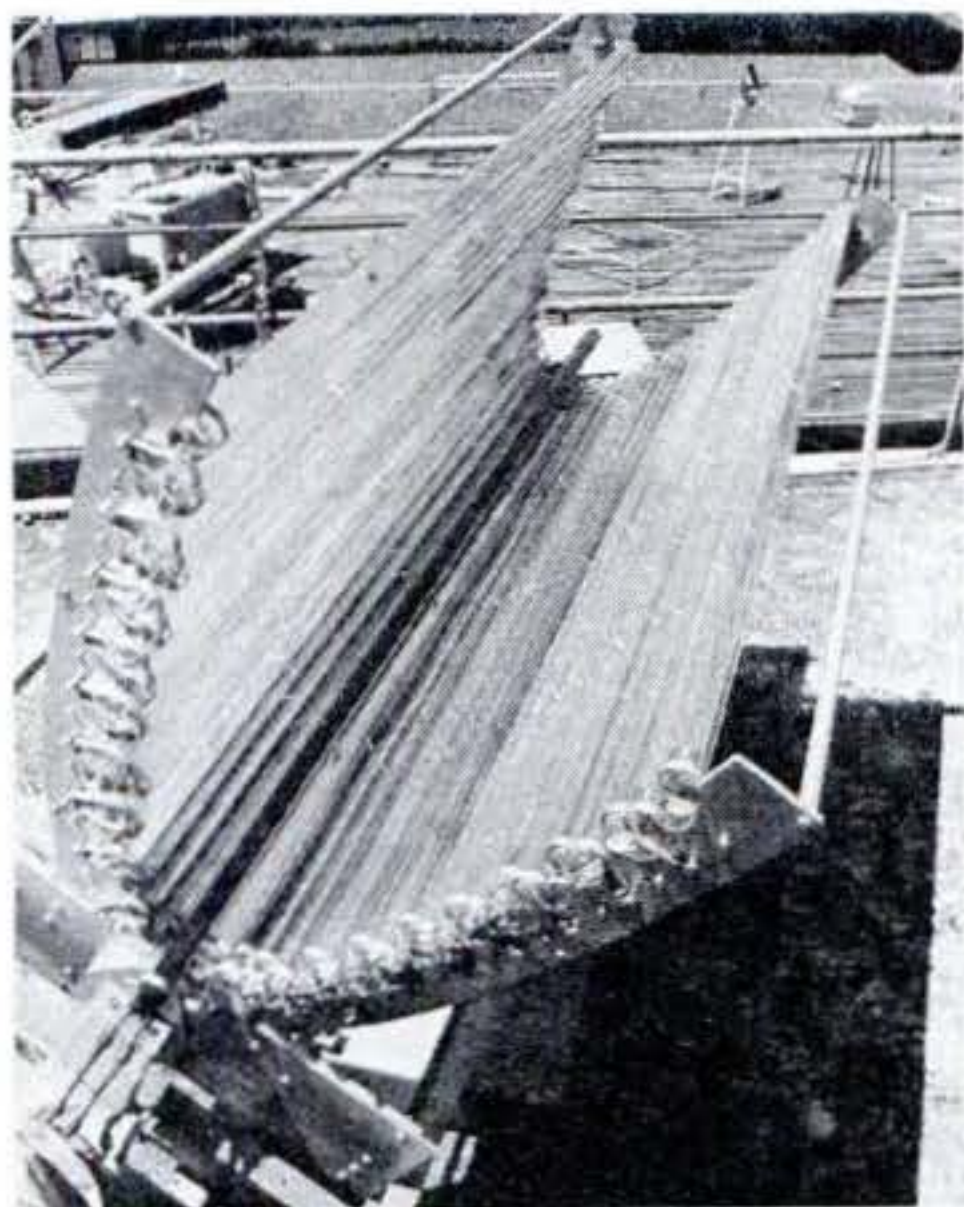
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Parabolic collector made of fluorescent tubes



The manufacture of fluorescent lights is a mature technology; forming metals into complex parabolic shapes for solar collectors is not. That's why scientists at the Center for Energy and Environmental Research at the University of Puerto Rico are attempting to use the common hollow glass tubes of fluorescents (which cost just a few cents apiece) to create a parabolic shape.

By inserting a Mylar-covered "facet" inside each glass tube and mounting the tubes in a simple frame, the mirrored surfaces can form the continuous curve necessary to focus the light on an absorber at the bottom of the parabolic "trough." Parabolic collectors of this design don't need expensive sun-tracking equipment and can produce 300-deg.-C steam, which industry can use for process heat. Besides reducing the cost of the collector, the glass tubes also keep dust and corrosive elements away from the reflecting surfaces.—Paul Bolon

Spray on
carburetor



NEW
FORMULA
SAVES
GAS

Pour in
gas tank



Now it's a meaner cleaner

New formula liquid Gumout now has extra muscle. Cleans deeper. Dissolves deposits throughout the carburetor. Flushes out PCV systems. Cleans deep into intake manifolds and valves. Helps engines run smooth. Saves gas, too. New formula Gumout is like a between tune-ups tune-up.

And use Jet Spray Gumout to clean carburetors inside and out. Cleans linkage, carburetor throat, throttle plate, choke valve shaft and vacuum cylinder.

Gumout is a division of the Pennzoil Company.



Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

9 mg. "tar", 0.8 mg. nicotine av. per cigarette, FTC Report Jan. '80.

**Take the road to flavor
in a low tar cigarette.**

*The low 'tar' with
genuine tobacco flavor.*



RALEIGH LIGHTS

PS | What's News

There was a time when a tent was something you took out of the car trunk and struggled with at the beginning of a camping vacation. No more. Relabeled "tension structures," tents are showing up as gigantic new commercial structures, some of them covering more than a hundred acres.

And they're not like the big top in the circus—meant to be put up for a day or two and then carted away. They are permanent buildings, meant to last from 20 to 40 years. Already they're being used in such diverse capacities as department stores, churches, and zoo pavilions.

A tent as a permanent building has a lot of advantages. It can be put up in dramatic and appealing new shapes. It can often use natural lighting exclusively in the daytime, cutting energy use. And it is often cheaper than the conventional structure it replaces.

You can get some idea of the dramatic design potential by glancing at the cover; the tension structure pictured is a stunning new airport terminal going up in Saudi Arabia. Susan Renner-Smith's article, beginning on page 56, will both tell and show you more.

The automatic factory

Recent articles in Popular Science described the growing fields of industrial robots [PS, June '80] and computer-assisted design [PS, Feb.] in which engineers use a computer and light pen to make preliminary drawings, do stress analyses, and refine the design of almost any product in a fraction of the time usually required. Now the General Electric Company has announced a plan to combine these two approaches and several others to produce something close to a totally automated production line. As GE sees it, once a product is designed on the computer, the computer can automatically control machine tools to make the parts. It would also direct robots to weld and assemble the parts into completed products. Then an electronic camera would inspect the product and feed the results back to the computer controlling the whole thing. The computer would also keep track of materials used, update inventories, order replacements, and perform all other necessary functions.

General Electric has not been involved in factory automation to any large extent

in the past. But with the new approach, combining various elements into a coordinated system, the company expects to become a major force in the field.

Energy predictions

With the prospect of a continuing energy shortage over the next several decades now accepted as fact by most authorities, a number of groups have been formed to study the problem, assess the size and seriousness of it, and make suggestions as to what we should do. Now comes the result of perhaps the most impressive of such studies to date. It was performed by the International Institute for Applied Systems Analysis in Vienna, using teams of scientists from 20 countries including the United States and the USSR. It is by all odds the biggest and perhaps the first truly global and long-term examination of the energy situation. It took seven years to complete, and it looks 50 years into the future.

Among the principal conclusions:

- Worldwide population will double to eight billion during the next half century. Even with only moderate growth and with extensive conservation, global energy demand will expand to three to four times today's demand.

- Meeting this demand will require the full use of all available energy sources—oil and gas, solar, renewables, and nuclear.

- The transition from heavy reliance on oil and gas to an economy based on renewable energy sources will actually be a double transition. The first will be from relatively cheap and clean conventional sources of oil and gas to more expensive and dirtier ones such as coal. It will continue through about 2030. The second, to the essentially endless sources of solar, nuclear, and renewable forms of energy such as wind, biomass, and ocean thermal energy, will go on until late in the next century. But once that transition is completed, says the report optimistically, such a system should be able to sustain the then-anticipated global population of approximately 10 billion people for many centuries.

How to win with ACES

ACES (annual cycle energy system) is a clever concept for heating and cooling a house that was developed at Oak Ridge

National Laboratory and has undergone extensive testing there [PS, Feb. '77]. It uses a heat pump to extract heat from a large tank of water to warm the house in winter. This forms ice in the tank, which then provides summer cooling for the house.

In its continuing investigation, Oak Ridge has now compared two variations of ACES with three other all-electric systems for home heating, cooling, and water heating.

The five alternatives were compared for 115 cities, using local weather data, local (1979) electrical rates, and 1979 equipment costs. Electric rates were assumed to increase at two percent each year.

Of all the systems, the ACES concepts used the least energy and proved to be the most economic in some areas over a 20-year life cycle. "ACES tended to win in climates where heating needs are about double the cooling needs," reports ACES program director Dr. Robert E. Minturn, and he gives Cincinnati and Pittsburgh as examples. But the winner in the largest number of cities was a high-efficiency air-to-air heat pump used with a waste-heat water heater [PS, Aug. '80].

In addition, 24 electric and gas systems were compared for the Knoxville, Tenn., climate. In this, a gas-fired pulse-combustion boiler [PS, Nov. '79] combined with an electric central air conditioner showed the lowest life-cycle cost. (This assumed that electric rates would rise at two percent annually and natural-gas rates at five percent.)

The study looked at technological advances—and prices—expected in 1990. Pulse combustion still looked good, tying for lowest life-cycle costs with one ACES variation. Close runners-up were another ACES and the overall winner in the first study—a heat pump with a waste-heat water heater.



Editor-in-Chief

Computer power

— pro models at almost home-unit prices

Are you ready to step up to a small business computer?

By WILLIAM J. HAWKINS

"Everybody. Everybody's using these systems," Fred Corsentino, manager of a New York Digital Equipment store, told me. "Store owners, doctors, architects, lawyers, people who work at home—everyone's finding uses for these machines. Even corporate executives are finding it's cheaper to use a small desk-top computer than to wait for time on the main-frame computer the company may own."

Small business computers are the latest and most serious evolution of the personal-computer market. They fill a gap—a \$7,000 gap to be precise—between top-of-the-line personal units costing \$3,000 (and a lot more if you add high-quality printers and other extras) and bottom-of-the-line regular business computers starting at \$10,000 (and going up into the millions). They're small desk-top machines about the size of a typical personal computer, but they're designed strictly for business. And you can buy one right at a corner store. Walk in, put down the cash, and your business is "computerized" in a matter of hours.

They're no whim. Nearly all the savvy personal-computer makers have at least one small business model available and, for the first time, large computer makers are now entering the field. Result: You can't open a newspaper or magazine without seeing at least one ad for a small business-computer system—at prices just undercutting the competition.

Great—but what are you buying? What makes the small business com-

puter different from personal models? What would you use it for? What should you look for when buying one? And how much will you pay?

As I found out, the \$3,000–\$10,000 spread accounts for major differences in hardware (the electronics) and software (the programming) in these systems. But perhaps the most important point I learned is this: When buying a business computer, the last thing you need to look at is the computer itself. Sound crazy? Sure, but here's why:

Package deal

A computer *system*—big, small, or in-between—requires four basic ingredients: a keyboard for entering data, a computer to manipulate the data, a display to get the data out, and some way to save the data for future use.

Many personal-computer makers supply you with two of the components—the keyboard and computer—and assume you'll have the rest. Many use your TV as a display, and most use a cassette recorder for saving data.

The most obvious difference with small business computers is that you get everything—they are sold as packages. Some units, such as the Zenith system on the facing page, come as an all-in-one desk-top box. Others, like the DEC system shown, are separate components that connect together. The result is the same: Buy a small business system and you get everything you need, basically, to do work. (Yes, the word "basically" does mean there's a catch—I'll get to that later.)

Besides an increase in hardware quantity, small business systems give you a quantum leap in quality. Unlike a personal computer, which gets limited use, business systems are intended to be used continuously. That means dependable components, but also a step up in less obvious ways.

The CRT display, for example, is designed for no-glare high visibility and high definition, so characters are extremely legible. That avoids eye fatigue over long periods of time. The keyboard has a standard typewriter layout for speedy touch-typing. It's also tough, capable of taking on the most powerful hunt-and-peck typist.

The data-saving device is the backbone of a system. Losing a month's records could literally result in bankruptcy for a business. Cassette recorders are too slow, too unreliable, and too limited for voluminous business records. Instead, a disk system is used. Thousands of pieces of information can be saved or retrieved in seconds on these units.

Printed information is important, as well, and many makers include a printer in the package. The printers used are sturdy, relatively fast, and produce very legible records.

If all this sounds good to you, you're right—all the small business systems I've seen are well engineered and designed for serious work. But what about that \$7,000 price spread?

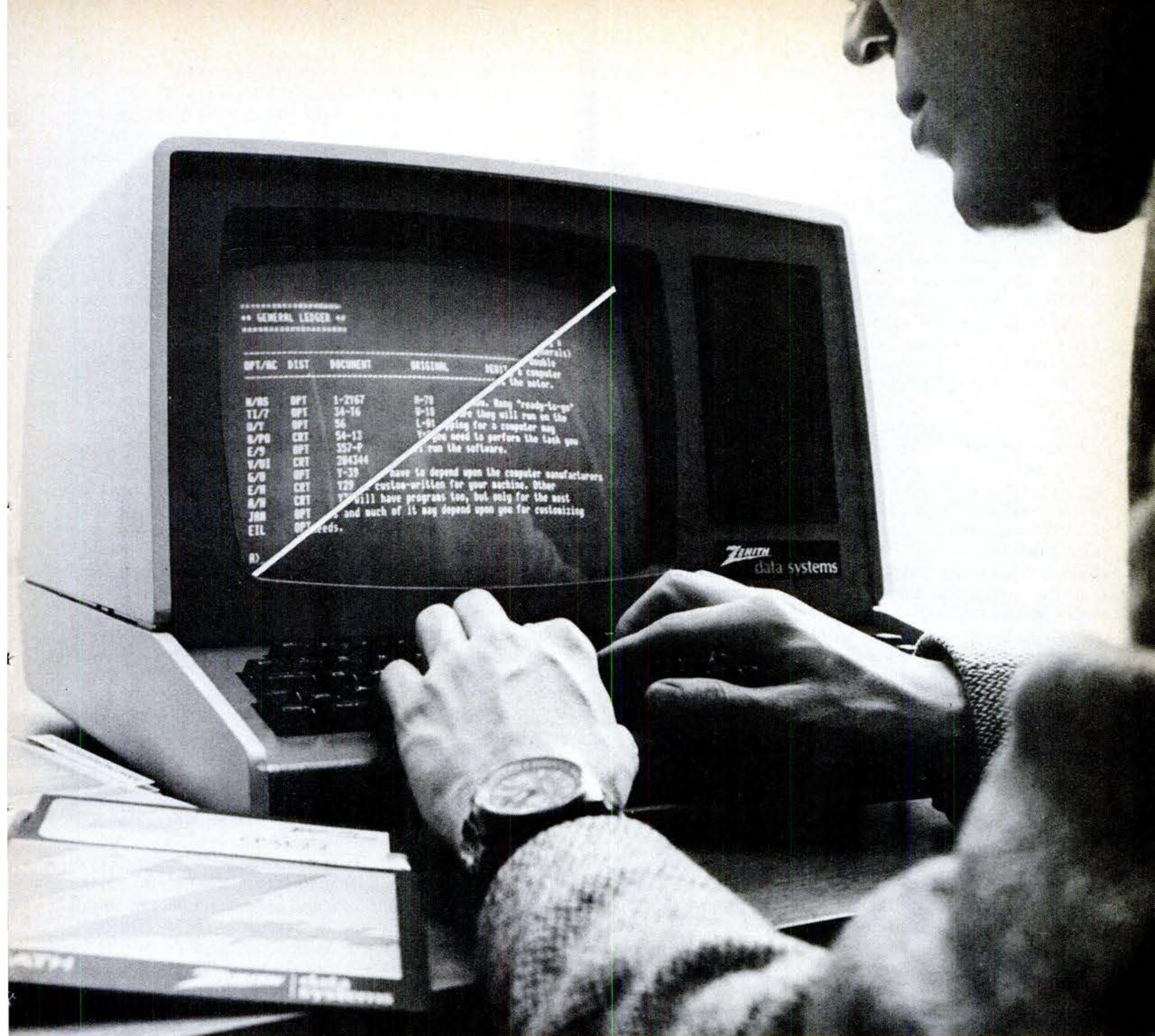
Bring your calculator

\$4,995. That's the advertised price for Digital's word processor/accounting system. That's good, since it includes a printer and a dual disk-drive system (two disk readers in one box, for double the storage).

"But that's the basic package," said Fred Corsentino when I asked about using one for writing articles. "That includes a 'draft'-quality printer. For finished work, you really need a 'letter'-quality printer."

A draft printer mechanically creates each letter (usually with a series of small dots). The print is legible, but not typewriter quality. For finished

Continued



Text editing, accounting, filing, electronic mail—just pop in the floppy disk and these systems are ready to go. Zenith, top, is all in one. Additional disk drives are plugged into rear connectors. The Digital system (DEC), left, comes as components that simply plug together. Basic system can be updated with letter-quality printer.

work—reports, business letters, documents—a letter-quality printer is recommended. The price of the system with the better printer: \$7,295.

Now the system is physically ready but empty-headed; it doesn't know word processing from shining shoes. For that it needs software: Digital's word-processing software is another \$500. Add \$400 more if you want to add mailing-label and file-sorting capabilities. Add another \$750 for accounting purposes (which most people get, I was told). Finally, add \$150 for your training. Total: \$9,095.

Sound unfair? Not really. The idea is to offer a basic "system" required by everyone and add specific pieces only as you need them. The practice is common. Radio Shack's Model II starter system is \$4,727. Add what you'll need for text editing and the price jumps to \$6,197. Add complete business-package capabilities and you're \$8,766 lighter than when you walked in.

Each jump in cost means an increase in capability: more powerful software, better and faster printing, greater data-storage capability. How do you know just how much storage you need? You don't. But then you don't have to.

Buying a system

You may be a doctor tracking bills, a dentist cataloging fills, or a lawyer creating wills—every business has its own special jobs a computer can perform. But the trick to choosing a computer is not to treat it like a machine: Treat it as a possible employee. You have a job that needs to be done; you need someone (or, in this case, some thing) to do it.

"Personal-computer buffs may buy a machine, bring it home, and then spend the rest of their time looking for things it can do," said John Morgan, manager of one of Radio Shack's newest computer centers. "In business, it's the other way around. Here you know the job—you have to find a machine that will do it."

More precisely, you have to find software that will do the job. Finding a computer to use the software you've selected becomes secondary.

There are literally hundreds of programs designed for small business computers. Odds are, however, that none will do everything exactly the way you want it done. The less-expensive programs are dedicated—they work one way and you may have to change your habits to work with them. A step up are user-oriented programs. These may be changed slightly—at least meeting you halfway in your normal procedures. All these programs come off the shelf: You buy a disk containing the data and an instruction manual, then go to work.

Most programs are text editors for creating everything from books to letters, or accounting packages for accounts payable to receivable. But more varied programs are being introduced daily: filing, electronic mail, building construction, report making, legal information, inventory control, real estate—even programs to check your spelling.

You can also buy a computer language—BASIC, FORTRAN, COBOL—which allows you to write your own programs. And there are utility programs designed to make better use of what you already own. A "spool" util-

ity, for example, allows the computer to type up a document on the printer at the same time you're entering new data at the terminal. Each program—from dedicated text editors to utilities—will require specific types of hardware. A text editor needs a letter-quality printer, for example, and an elaborate accounting program may need two disk-drive units instead of one. The point: First choose the software that does the job—then back it up with the machine needed to do it.

The combination of programs and machines can be overwhelming. But to help you, many computer makers are opening retail stores. Besides Digital, Heath, and Radio Shack, which have been in operation for some time, IBM, for example, has recently opened two trial stores in Baltimore and Philadelphia. Xerox has opened 13 stores around the country. Control Data has four stores: two in St. Louis and two in Kansas City. Many other makes, such as Zenith, Vector, Commodore, Ohio Scientific, North Star, and Apple, to name just a few, are being sold through local computer centers around the country.

The idea behind these stores is simple: Offer a quick, reliable, and practical solution to any business problem. The results, however, could go far beyond that.

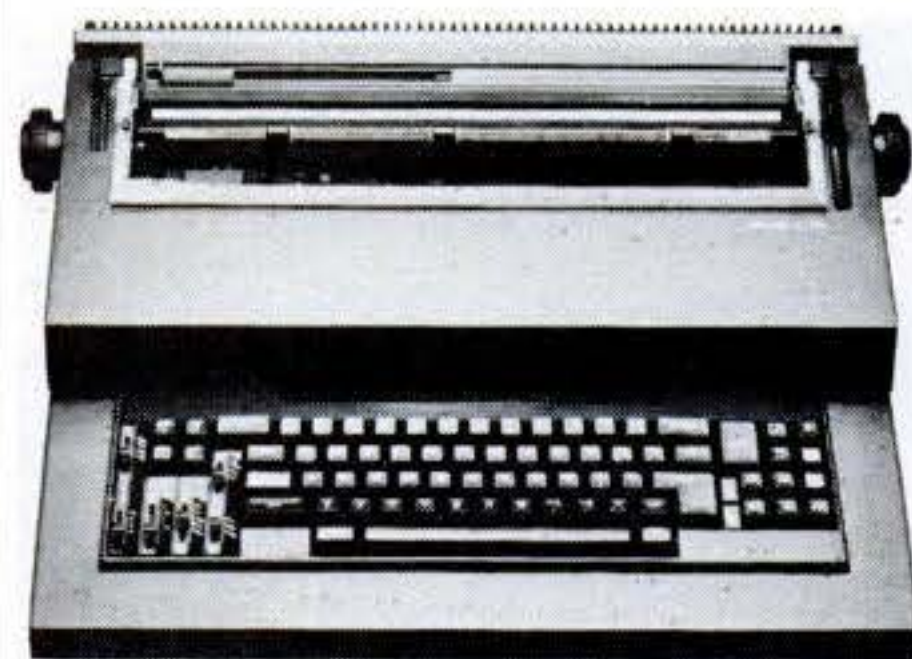
For the first time, small-business operators can take advantage of big computer power at a modest cost. That alone could change the very fabric of a "small business" operation. Products, services, and even employment could change dramatically. How? By how much? At present, as they say, that does not compute. 15



Radio Shack II starter system has a built-in disk drive and comes with a draft-quality

printer. Additional drives are connected to the rear of the machine.

Text-editing alternative



Smart typewriters, like this Olivetti ET 231, don't put words on paper until you're ready. As you type, lines are shown on a 15-character LED display and stored in memory (holds up to 16,000 characters temporarily). Editing and corrections can be made instantly using the display. Prices start at around \$2,000, but the small display is limiting when editing large documents.

The great gasohol debate

It's 90 percent gasoline and 10 percent ethanol. But that's about all the pro- and anti-gasohol camps agree on

By **EDWARD EDELSON**

In his "PS/What's News" column in the February issue, Editor-in-Chief C. P. Gilmore reported on a study done by Wallace E. Tyner, associate professor of agricultural economics at Purdue University. Professor Tyner has been investigating the broad effects of increasing our alcohol production for use in gasohol, the auto fuel. He concluded that at the four-billion-gallon level (per year of alcohol production) there appears to be a significant possibility of a 30-percent increase in the price of corn. Meanwhile, a world grain shortage is threatening. Mr. Gilmore wrote, "Thus as the cost of oil continues to rise, the price ethanol makers can pay for corn goes up, and corn quickly becomes more valuable as a fuel substitute than as cattle feed, which accounts for most of the use of corn now. So while ethanol as a motor fuel may reduce the amount of oil that needs to be imported, it will also help jack up meat prices."

The news item was aptly titled "The Gasohol Controversy"—it certainly touched off a controversy among our readers. Many wrote to us protesting Tyner's contention that producing large quantities of fuel alcohol (ethanol) from corn would drive up the price of food. A couple of representative letters are printed in this month's "Readers Talk Back" column. But the issues involved in the gasohol controversy proved too complex to explain in the brief space available in "Readers Talk Back." So we dispatched noted science writer Edward Edelson to explore the whole gasohol question. Here is his report.—*The Editors*

The gasohol scenario, take one: Alcohol for fuel is America's ace in the hole. It will help us thumb our nose at the Arabs, provide a welcome new source of renewable energy, ease the up-and-down cycle of agricultural prices, and help many farmers achieve energy self-sufficiency by running their own distilleries. All with little effect on food prices.

The gasohol scenario, take two: Alcohol for fuel is a disaster in the making. It will never provide more than a trivial part of our energy needs, will accelerate the destruction of American crop lands, drive more small farmers out of business, and divert foodstuff from the hungry to the automobile. If we really go at it seriously, it will add tens of billions of dollars to the American food bill.

I've heard both versions of the fuel-alcohol story lately, expressed with equal vigor by proponents and critics. To the critics, a big catch in the scheme is that most of the alcohol is supposed to come from corn. Theoretically, alcohol can be made from any kind of vegetation (or even from garbage). But for a variety of reasons the most likely feedstock for large-scale fuel distilleries in the U.S., now and in the near future, is corn.

So it's a simple question of bread versus fuel, right? Not at all. Instead, the argument concerns a complex set of interactions involving, primarily, these five questions:

- What are the economics of gasohol?
- Do you use more energy to make alcohol than you gain?
- What would additional demand for corn do to our farm land—and to farming?
- Would gasohol help our balance of payments?
- And the big one: Would using corn to produce fuel send food prices skyrocketing?

Ultimately the debate may hinge on what today are unknown factors—but matters of conflicting studies, differing projections, and very vocal opinions. Here is what we know—and don't know—about those five questions.

Gasohol economics

To understand the economics of fuel alcohol, you should first realize that gasoline and alcohol are not equivalent fuels. While a gallon of gasoline contains 115,400 Btu of heat energy, a gallon of ethanol contains only 75,760 Btu. On the other hand, alcohol is a higher-octane fuel than gasoline and serves as an octane booster in the gasohol blend. That means the gasoline in the mix requires less refining, which saves energy at the refinery. All factors considered, a gallon of ethanol nets about eight percent less energy than a gallon of gasoline. Gasohol, then, delivers about one or two percent fewer miles per gallon than gasoline, according to Wallace E. Tyner of Purdue (who, it turns out, is not anti-gasohol at all). So any valid comparison of gasoline and gasohol must be on a miles-driven-

Continued

per-dollar-spent basis, not on a gallon-for-gallon basis.

Right now it costs more to produce a gallon of alcohol than it does to produce a gallon of gasoline. Fuel alcohol is competitive with gasoline because it gets tax subsidies: Gasohol is exempted from the four-cent-a-gallon federal gasoline tax, and since each gallon of gasohol contains 10 percent alcohol, that amounts to a 40-cent-a-gallon federal subsidy for the alcohol. Twenty-five states also give tax benefits to gasohol. With these subsidies, gasohol today is competitive with gasoline on a miles-driven basis, but it wouldn't be without them.

Recent history, however, mostly shows the price gap between alcohol and gasoline closing rapidly. Tyner points out that from early 1978 to early 1980 the refinery-gate price of gasoline more than doubled—from 45 cents a gallon to 95 cents—while the cost of producing anhydrous (water-free) alcohol increased only about 25 percent—from 95 cents to \$1.21 per gallon.

A year ago it seemed likely that the price gap would continue to close. But events took an unexpected turn this year: Gasoline inventories started building until, by spring, there was a virtual glut on the market. That helped to stabilize prices. "Before this happened I expected alcohol to be competitive with gasoline within two or three years on a miles-driven basis without any tax subsidies," says Tyner. "Now I'm not so optimistic." (But he still expects it to be competitive before 1992, when the federal-tax exemption is scheduled to expire.)

Another factor in the equation, the price of corn, has also taken an unexpected turn—sharply upward—thanks to the fickle hand of Mother Nature. Don Fink, a policy analyst who has done several detailed studies of fuel alcohol at the Department of Agriculture, says, "In 1979 there was a bumper corn crop of 7.6 million bushels. It sold for \$2.50 a bushel, and at that price a distiller with a 50-million-gal-

“The Arabs can always say, ‘We’ve had enough.’ If they set their prices so alcohol can’t compete, that’s it”

lon-per-year still (large by today's standards) could make a profit by selling alcohol for \$1.20 a gallon." (A 10-million-gallon plant would have to sell the alcohol at \$1.55, Tyner says.)

In 1980, however, the corn crop was down 17 percent because of a killer heat wave. "Corn rose to more than \$3 a bushel, and in some areas more than \$3.50," Fink reports. Every 10-cent-a-bushel increase in corn costs bumps the price of alcohol by 2.8 cents a gallon. "If we have another bad corn-crop year, you could see corn at \$4 or \$4.50 a bushel," Fink says.

Okay, gasohol proponents concede, the price of alcohol will go up and down with corn prices. But the price of gasoline will only go up as OPEC pulls that string. Don Fink, though, thinks that the oil-producing countries will be too shrewd to keep the economic balance tilted in favor of gasohol. "The Arabs are always in a position to say, 'We've had enough,'" he says. "If they set the price of crude so alcohol can't compete, that's it."

In such a case, it could be argued that the threat of competition from alcohol had at least served to keep a lid on oil prices. But the sum of the argument is this: Since no one can predict either the future price of corn or the future price of crude, the economics of gasohol is still uncertain. The economic value of a principal byproduct of alcohol produc-

tion, distillers dried grain (DDG), is also unclear. I'll discuss it later.

Energy balance

Several experts have argued that alcohol fuel is not a good bet because it takes more energy to plant, tend, and harvest the corn and to distill the alcohol than you get out of the alcohol. Others claim that there's a net energy gain. The primary reason for the argument is that these analysts are looking at different technologies. Most plants making fuel alcohol today were originally set up to produce high-quality, high-purity drinking alcohol. And a lot of them were built when energy was cheap. These plants are not energy efficient, and analyses based on them indicate a negative net energy balance. Studies that show a positive net energy balance look at the more-efficient plants now being built, which are made especially for fuel production [PS, Mar. '80].

The other side of the energy-balance coin concerns the type of fuel burned to distill the alcohol. Today alcohol plants burn oil or natural gas, but the assumption is that future plants would burn coal. Thus, many experts say, it's not really a question of energy balance. (On that basis, they point out, electricity would be regarded as impractical because 60 percent of the fuel is wasted when it is burned in a generating plant.) Instead, alcohol should be regarded as one technology for turning coal into a more usable liquid fuel. If you were to burn a gallon of oil to produce a gallon of alcohol, it may be a questionable proposition. If instead you burn coal, you're ahead. And if you burn cornstalks, you'd be way ahead.

The fate of farm lands

Critics of a full-scale alcohol-fuel program see it as a potential threat to a basic resource—farm land. "As the industry expands to meet rising demand for corn, there may be a tendency to bring more marginal lands into production," Don Fink explains. "These lands are marginal for a reason. Either they're on slopes, so there will be greater soil erosion when they're plowed, or there isn't much water available."

Because more marginal land will be farmed, bad years will hit harder, causing great swings in corn prices. A study by the Congressional Office of Technology Assessment (OTA) concluded that small farmers and those who are just starting out will be especially hard hit by such swings. The net effect will be to shake these farmers out, increasing the monopolization of farm land by large agribusiness corporations, the study indicated.

The farm-land issue is exacerbated by the fact that the principal byproducts of alcohol production can be used as a high-protein animal-feed supplement, competing directly with soybean meal. As alcohol production increases, says Tyner, the price of the byproducts may drop and soybean meal will be pushed out of the market. Farmers will then grow fewer soybeans. That trend would be reinforced by the demand for corn as a fuel feedstock, he says. It is standard practice to plant a field to corn one year and to soybeans the next. That breaks insect and disease cycles. And soybeans actually add nitrogen to the soil while corn takes it out. With increasing corn prices farmers may tend to plant corn every year. Result: More pesticide and fertilizer would be used.

Balance of payments

Today this country is paying for a lot of OPEC oil and Japanese cars by exporting farm products, including corn and soybeans. If we made corn into alcohol and produced fewer soybeans, we would reduce those exports. The effect on the balance of payments is hard to determine.

But Tyner believes that question is beside the point. "The prime concern is national security," he says. "We would be willing to break even on the balance of payments."

Would we at least break even? That's another imponderable. "Some economists have suggested that the economic cost of imported oil today is really \$70 to \$100 a barrel," says Milton David, an agricultural economist who heads a

“ The issue is not taking bread out of the mouths of the hungry, but meat from the plates of the well fed ”

firm called Development Planning and Research Assoc. "What is the economic price of exporting corn, in terms of the strength or weakness of the dollar and the cost of food domestically? There is probably a trade-off here that no one has really addressed."

Certainly the biggest bugaboo the critics of alcohol fuel point to is how such a program might affect food prices. This, too, is complex and largely unpredictable.

People eat very little of the corn grown in the United States: 90 percent of it goes to feed livestock. Though in the long run the price of one grain will affect that of all the others, the immediate issue is not taking bread out of the mouths of the hungry, but meat off the plates of the well fed.

Whether that will happen—or to what extent—centers on the residue left after the starch is removed from the corn to make alcohol. Many stills in use today employ what is called the wet-milling process. Residue left from that is gluten meal, a high-protein product that can be fed to chickens, hogs, and cattle. There is a ready market for it both domestically and abroad, Tyner says.

But another technology, the dry-milling process, requires a lower capital investment, gives a higher alcohol yield, and is the only suitable one for use on the farm, says Tyner. The byproduct of dry milling is distillers dried grain. Any large-scale alcohol-fuel program is likely to produce a lot of DDG. One bushel of corn yields 2.5 gallons of ethanol and about 17.8 pounds of DDG—now worth about \$1.13. To make alcohol production economically feasible the distiller must find a market for the DDG.

Like gluten meal, DDG is high in protein. "It has more protein than was present in the original corn," says William A. Scheller, a chemical engineer at the University of Nebraska and an early enthusiast for gasohol. "The excess is from the yeast that turned the corn carbohydrates into alcohol. DDG is about 30 percent protein."

Scheller and other gasohol proponents cite studies done at the University of Nebraska and elsewhere that found that cattle gained more weight on a diet including DDG than they did on corn. But many experts point out that DDG is not suitable for other animals. Don Fink says that it can't easily be fed to hogs and chickens. "DDG contains all the corn's fiber; non-ruminants can't digest fiber."

That limits the DDG market to cattle, Fink says, and "about 40 percent of the cattle in this country are range-fed. That doesn't leave much of a market for DDG."

Thus, some experts say, we could end up with more DDG than anyone can use. Lynn Doxon, whose Tallgrass Research Institute in Formosa, Kan., makes a still for farm use [PS, Jan.], disagrees on the grounds that people, too, will be eager consumers of DDG. "If you make it under sterile conditions, you can put it in bread or anything in

which you use bran or wheat germ," she says. "We've made cookies with it and they were delicious."

Maybe, maybe not, says Milton David. "Technically it can be made palatable," he admits. "But it probably wouldn't be high on your preference list. And the cost of converting it to an edible protein is rather high."

Whatever the market for DDG, a greater demand for farm products would likely drive up the price of land; that, too, could put upward pressure on food prices. According to the Congressional OTA study, "Rough estimates based on the expansion of crop lands in the early to mid-1970's [due to the increased demand abroad for U.S. food exports] indicate that domestic food consumers could pay \$3 to \$4 per year in higher food prices for each additional gallon of alcohol produced above the level at which the food-fuel competition becomes severe, if grain prices are used to bring more crop land into production and if distillery byproducts are utilized poorly."

At what level of alcohol production would the food-fuel competition become severe? Different experts come up with different numbers. According to the OTA, the food-fuel collision could come at a relatively low level of alcohol production—no more than two billion gallons a year. To put that into perspective, two billion gallons a year is 130,000 barrels a day. Our oil imports now are almost seven million barrels a day (294 million gallons).

Some experts believe that our fuel-alcohol production will never rise much above the two-billion-gallon level. John Long, technical director of Archer-Daniels-Midland, which produces about 80 percent of the nation's fuel alcohol today (and is expanding its capacity), doesn't see a really big industry based on alcohol from corn. "Three billion gallons is where it will end up," Long says. "It'll probably be used as an octane improver."

The National Alcohol Fuels Commission, which was established to study the effect of a major expansion in alcohol fuels, thinks production could go considerably higher. "We see the upper limit being five billion gallons a year before there would be major effects on the price of corn," a commission spokesman said.

It's a guessing game

Actually, most experts acknowledge that they're guessing about corn prices when and if alcohol production goes over that two-billion-gallon level. "We need to do some guessing because any model based on historical experience goes out the window," says Milton David. His guess: At two billion gallons the price of corn would go up about seven or eight percent. At four billion gallons the increase would be 20 to 25 percent. "I would guess the real price of corn would double at five to 10 billion gallons," David says.

"The real issue is the supply response to higher prices," says Tyner. "We've had increased production for years with declining agricultural prices. All of a sudden we have a major new source of demand. We don't know what's going to happen because we've never had this experience and we don't know all the interactions."

"We've got the Worldwatch Institute in this country saying that even without alcohol fuel the world food situation would be precarious. Others are saying that alcohol could be the single biggest new benefit for agriculture. It largely falls into the realm of belief at this point. I'm going to spend the next two years studying it."

Tyner is developing computer models designed to include all the major factors in the food-vs.-fuel area. It will take those two years to complete the studies. By most calculations, alcohol production will not have reached the two-billion-gallon danger level by then. Maybe before it does we'll have enough research and experience at hand to sort out the pros and cons of alcohol fuels. PS



Tension structures

make huge—and elegant—buildings

Giant tents designed by computer are efficient and durable

By **SUSAN RENNER-SMITH**

"We're designing buildings that respond directly to nature," said Horst Berger, co-founder of Geiger-Berger, a New York City engineering firm. He waved at the architectural models scattered over tables and shelves.

"We make these things so the snow slides off, the heat reflects, and the light comes through. And when it rains, they make a beautiful waterfall for us," he said delightedly.

Berger was talking about tents. Architects call them tension structures, but they're really just big, beautiful tents, some covering more than

100 acres. Giant tents are popping up all over the globe. A partial list includes a California department store, an African church, a Boston zoo pavilion, and a Saudi air terminal.

These modern tents, designed by computer and made of Teflon-coated Owens-Corning Fiberglas, are almost permanent. They will last at least 20 years, probably 40.

Why pitch a long-lived tent? Despite their ethereal beauty, tension structures make surprisingly practical commercial buildings. They often cost less to build than conventional ones; they cut energy bills; and their striking designs draw people in.

How do you convert a piece of fabric into a sturdy building that will endure both hurricanes and blizzards?

"A tension structure has neither weight nor stiffness, the things that

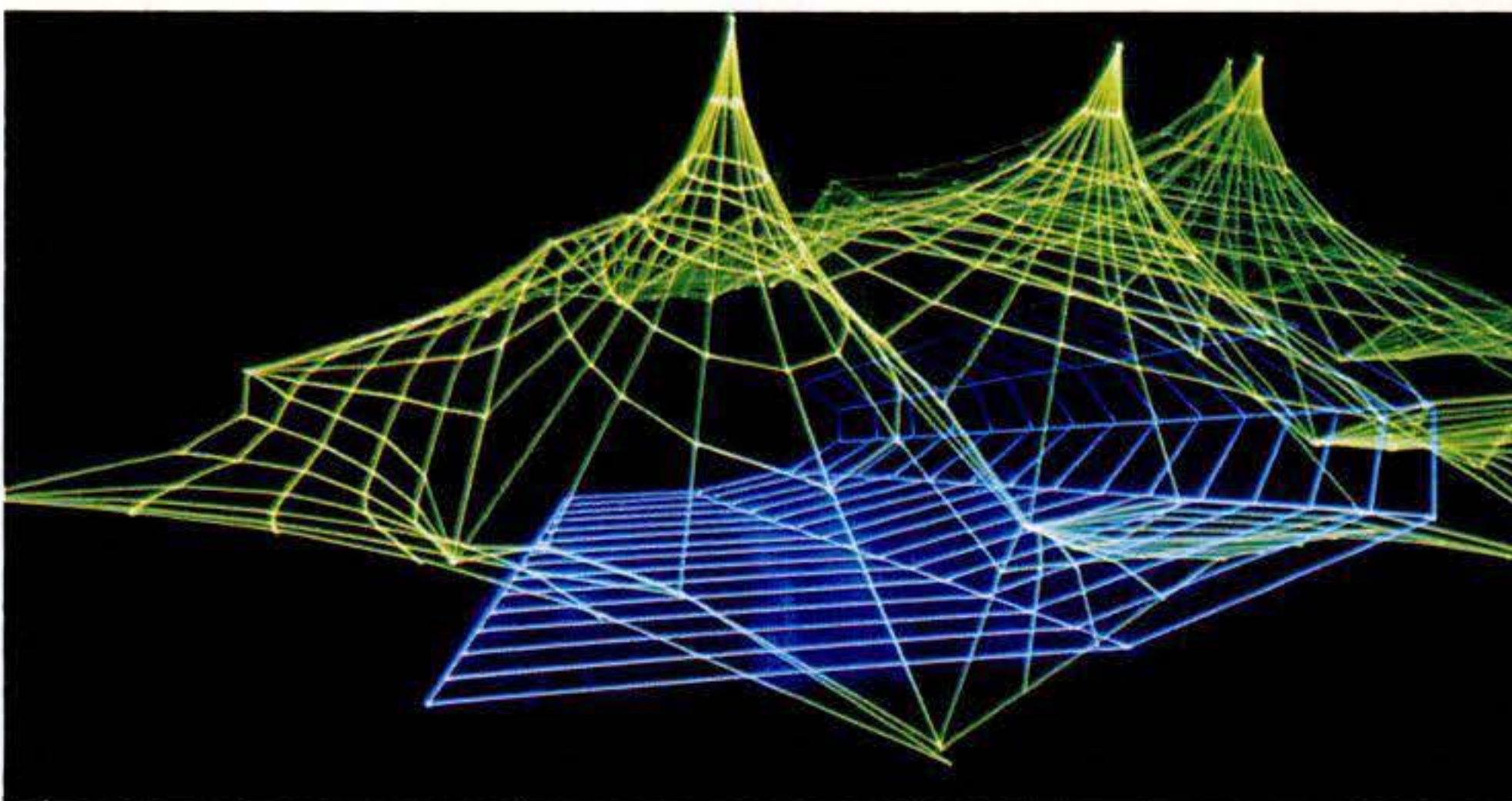
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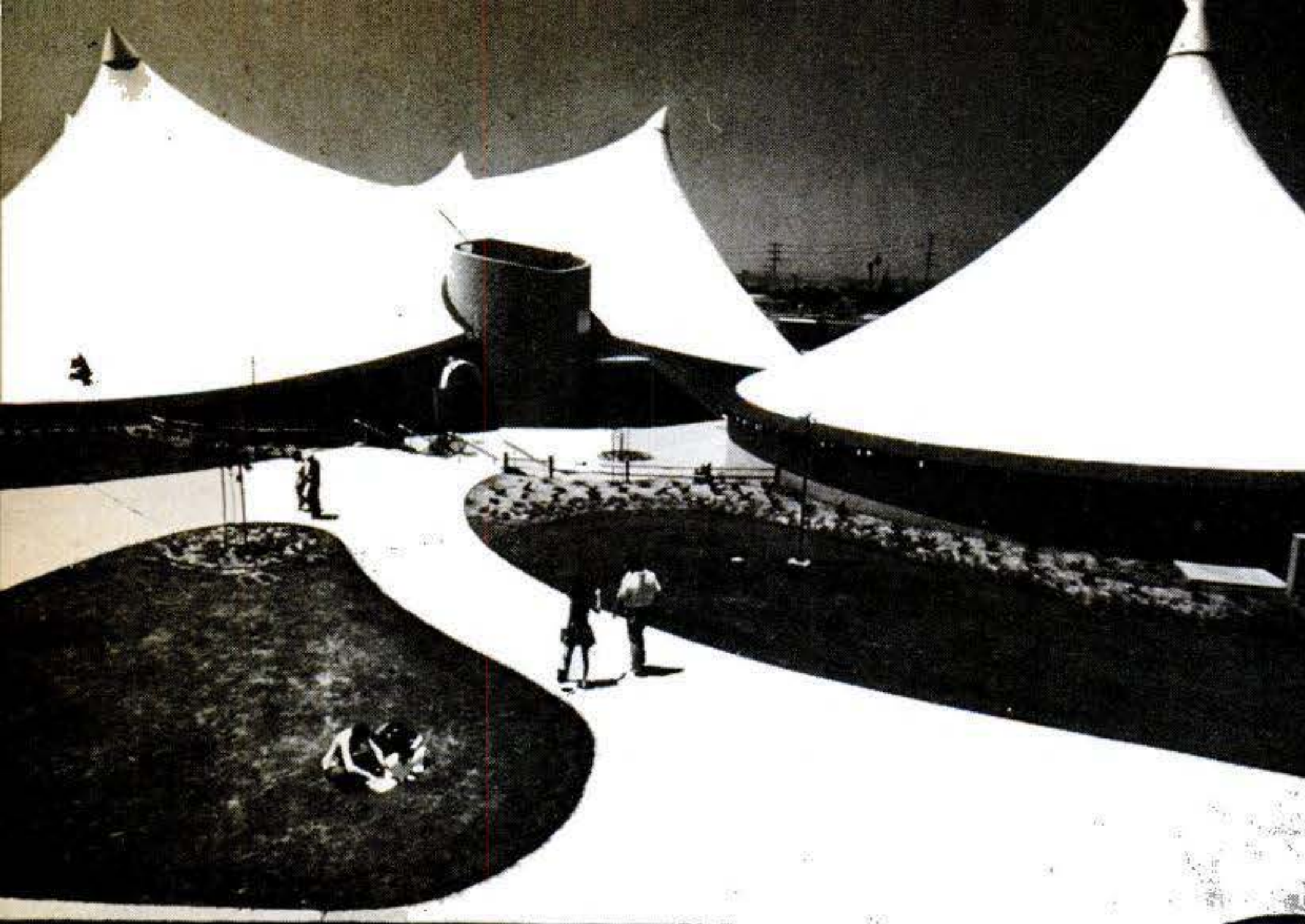
Silhouetted against the desert sunset (left), tents stretch between 150-foot-high pylons. When complete, the multi-tent roof will span 105 acres at Saudi Arabia's Jeddah airport. Fabric modules are cheaper to haul into such remote areas than

conventional materials, and the structures can be built faster. After erecting the supports, workers simply unfold the fabric, hoist it into place (above, during construction of Bullock's department store in San Jose), then tension it.



Intricate as a spider web, the computer-drawn design above traces the taut curves needed to shape fabric into a tension structure like the Florida Festival (left). Each warped rectangle in the drawing defines the shape assumed by the fabric

when tension is applied. The Florida structure's 70,000-square-foot roof forms five tents—one inverted so rain can create a dramatic interior waterfall. The swooping shapes shelter a shopping arcade at Sea World in Orlando.



Students relax (above) inside the first permanent tent (top left). Pitched at California's La Verne College in 1973, the 1.4-acre structure still needs little maintenance. Soaring, saddle-shaped panels (above right) form a new tension structure at Boston's

Franklin Park Zoo. The finished building will span 220 feet and house hippos and crocs amid African foliage. The tropical plants should flourish as they have inside other tension structures (top right). The reflective roof admits light, prevents heat buildup.

make ordinary buildings stable," said Berger. "We have only fabric and cables—so we must add both stress and curvature."

The fabric can be stretched over arches, tensioned by a central mast, or stretched between cables hung from an outside frame. But however the fabric is mechanically tensioned, it must have built-in tension, as well. To keep its shape, the fabric is designed so that intersecting stress lines curve in opposite directions. Each fabric section swoops out and down at the same time.

Determining the precise curvature of each fabric piece and the exact amount of prestress needed is a tricky job—but not for today's computers.

"We have a brand-new interactive graphics computer," said Lora Spiller of Chemical Fabrics Corp., one of the two major firms that fabricate and erect tension structures. "We just plug in a few numbers, and the computer designs the shape," she said.

The numbers used are indeed few—

several sets of Cartesian coordinates for cable support and anchor points, a few more for the fabric grid, and one equation for stress.

"We're reversing the design process," Berger said. "Normally you choose an arbitrary shape for a building, and then you analyze it to find out the stresses it will withstand. Here we put the stress in first, and let the computer decide the shape."

Computer design makes building-size tents possible; Teflon-coated Fiberglas makes them practical. Pound for pound, woven Fiberglas is stronger and cheaper than steel. Unlike the vinyl-coated polyester used for the familiar tennis bubble, this tough fabric won't burn, lose strength, or soil. The non-stick coating makes the tent self-cleaning and practically maintenance-free. And Teflon bleaches white in the sun, so the fabric is reflective as well as translucent.

The super-fabric can range from a weave with seven-percent light transmission and 75-percent reflectance to

one with a transmission-reflectance ratio of 22:69. But even the least translucent fabric transmits 60 foot-candles of diffuse light on a cloudy day, according to Owens-Corning Fiberglas Corp., the other major builder of tension structures.

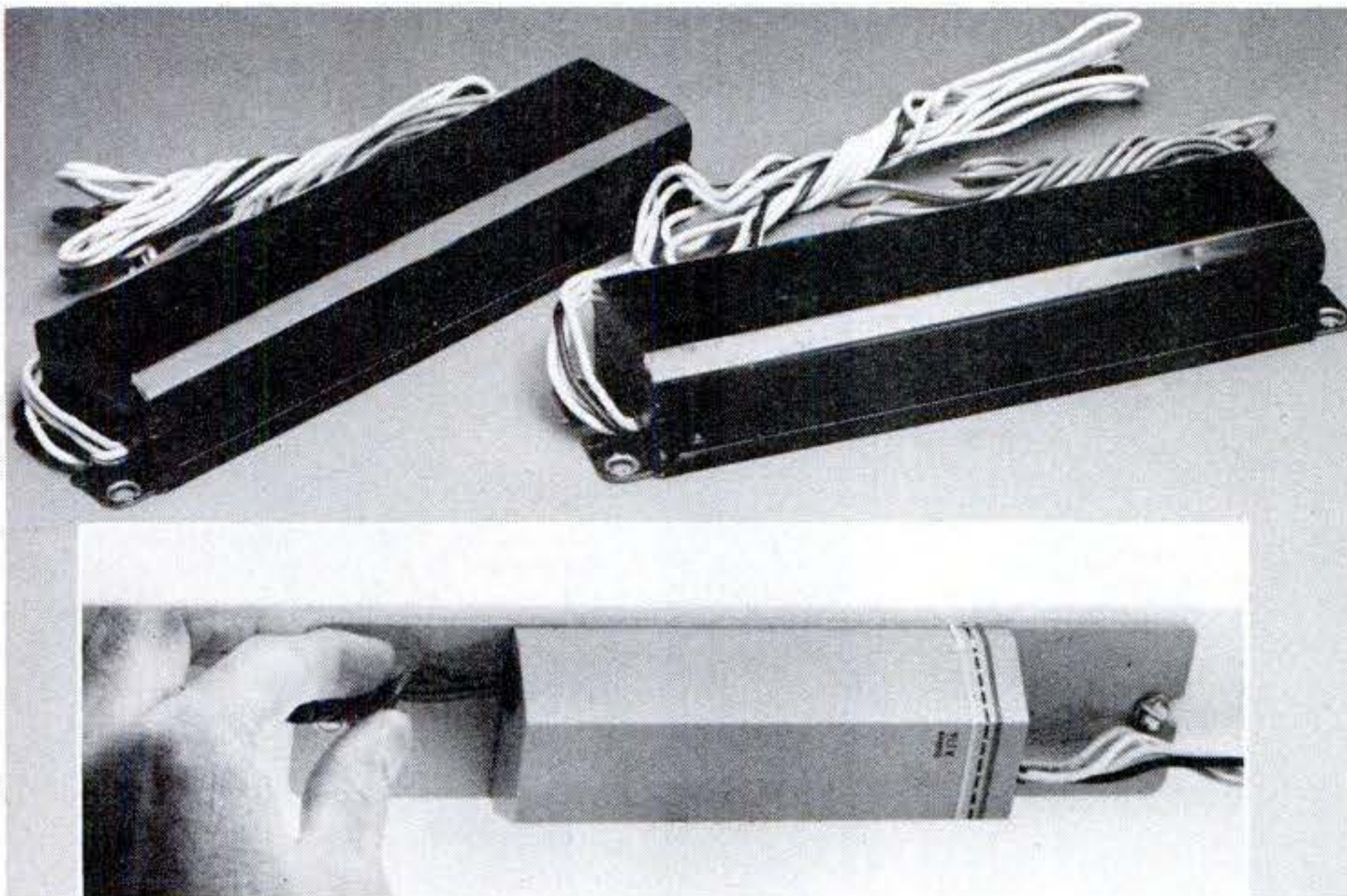
That's enough light for most activities, so the translucent roof slashes lighting bills—a key energy cost for most commercial buildings.

In cooler climates, such energy savings may be offset by winter heating losses. But tension structures can be insulated with double air-trapping layers of fabric. Berger and others are now working to perfect a super-insulating fabric that will have maximum light transmission.

And the translucent tent offers more than energy savings. "Everyone responds to it," said Lora Spiller. "Shoppers like the dramatic shape. Retailers like the soft light. Even the palm trees seem to like it," she added. "They grow 42 feet tall in that beautiful, natural light."

Computerized ballasts

cut fluorescent-lighting costs



Three fluorescent lamps can be driven by Thomas Industries' computerized ballast,

Electronic fixtures cost more, but makers stress energy-saving dollars

By JOHN FREE

As workers stream into U.S. offices and plants each weekday, some 400 million fluorescent-lighting fixtures are switched on. Fluorescents rank about midway in efficiency (75 lumens per watt) between incandescent and high-pressure-sodium lighting ["Energy-Saving Lighting," PS, Sept. '80]. By one estimate, however, more than half the energy consumed by 150 billion watts' worth of office fluorescents each year is wasted. The culprit? Too much lighting:

- As the sun adds natural light to offices, most fluorescents blaze away at full output.
- Unused or seldom-used office space is often overlighted.
- Since fluorescents dim with use,

shown being installed (inset). Old-style ballasts (above) run only two lamps each.

buildings are designed to be overlighted to compensate for aging.

Building managers faced with soaring energy bills have removed some fluorescent lamps from sockets. But new electronic ballasts being introduced by several companies promise a less drastic approach to saving energy—plus new operating convenience. A few of these new ballasts are equipped with tiny microcomputer circuits for special advantages.

Higher frequencies

A conventional ballast consists of an iron-core transformer and a few simple electrical components. Its function is to trigger an arc between the fluorescent-tube electrodes and regulate current flow when the gases fluoresce. Heat given off by 60-Hz line-voltage losses in transformers may add to the air-conditioner load.

New electronic ballasts eliminate the bulky, heavy transformer. Circuit design varies, but 60-Hz line voltage

is electronically "chopped" with a power transistor to 12–32 kHz. This high-frequency voltage, fed through a compact ferrite-ring transformer, makes the phosphors glow brighter. "Since you get more brightness, the incoming power can be reduced to save energy," says David Cooper, president of EETech, a division of Beatrice Foods Co. (Chicago, Ill.).

EETech will add a model to its electronic-ballast line this year capable of dimming fluorescents and saving even more energy. A solid-state triac, used in ordinary incandescent-lamp dimmers, can trim line voltage in fluorescent circuits, too. Lighting can then be manually preset to any level or controlled automatically through sensors measuring ambient room light. One firm, Controlled Environment Systems, Inc. (Box 1190-B, Rockville, Md. 20850), markets an intensity-controller/sensor system you wire to existing ballasts.

With electronic ballasts, a circuit can also be included to compensate for tube aging; brightness remains constant. General Electric uses a conventional analog circuit for this job in some of its existing fluorescent-lamp models. But GE is introducing a newer model with a microcomputer chip to compensate for aging.

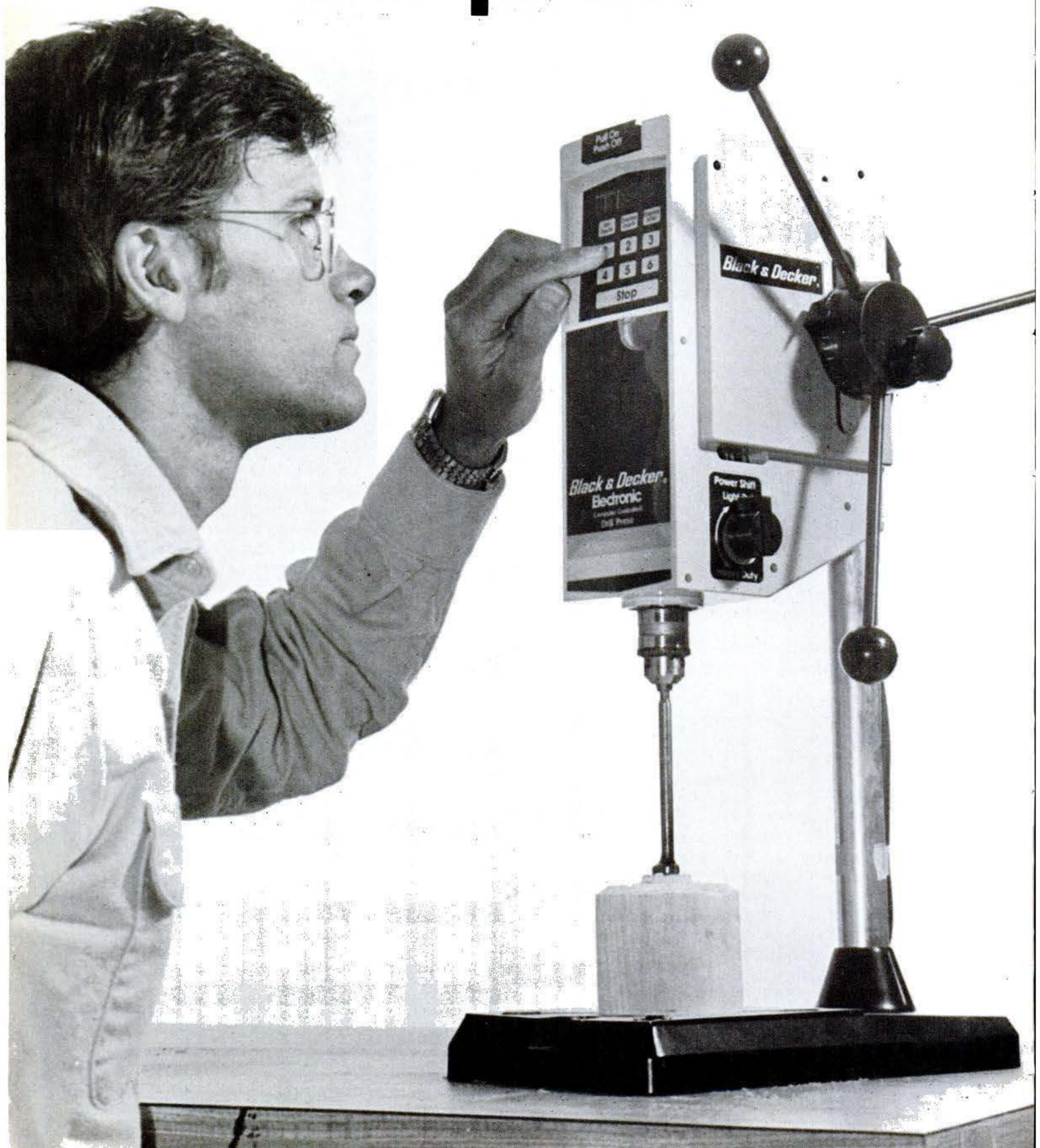
Since each ballast computer can have its unique digital "address," lamps can be controlled from a central location by sending coded radio-frequency (RF) signals to each fluorescent fixture. Lamps in sections of, say, a factory could be dimmed or shut off by a larger, separate computer.

Thomas Industries Inc. (Louisville, Ky.) won't reveal details about its new computerized ballast. But the company stresses that its electronic ballast has 50 percent more capacity than the transformer type, since it can drive three lamps compared with two for a standard ballast. According to Thomas, a test with energy-saving lamps showed that its computerized ballast (supplying three lamps) required 20 percent less power than the two ballasts needed for a standard three-lamp fixture.

Electronic ballasts cost from \$22 to \$30, compared with \$4 to \$7 for standard ballasts. Payback time for energy savings varies with utility rates. In a 100,000-sq.-ft. building with 2,000 Watt Watchers using 630,000 kW-hr annually, Thomas figures that electricity in Chicago (7¢/kW-hr) would cost \$44,100 versus \$56,700 for standard ballasts. In New York City (11¢/kW-hr), the firm figures, computerized lighting would cost \$69,300 instead of \$89,100 for standard fixtures with energy-saving lamps. ■

First report:

computerized drill press



At the push of a button: depth-of-cut and rpm readouts while you drill

By A. J. HAND

PHOTOS BY THE AUTHOR

What do you get when you combine a tiny computer chip with a 3.3-amp variable-speed motor, then add a chuck, housing, and base? The brand new Black & Decker Electronic Drill Press—the first computerized tool for the home shop. (PS first told you about this new tool in the Nov. '80 issue.)

When one of the first of these tools to come off the production line arrived at my door, I promptly unpacked it and put it to work to see just what the computer could do. Here's what I found out:

You and the computer communicate through a touch-sensitive control panel and an LED readout screen. At the touch of a finger you can select your drilling speed, set drilling depth, or ask the tool to give you rpm or depth readouts *as you drill*.

Let's go through a typical shop operation and see how all this works. Say you want to drill a 3/4-inch-diameter hole in a wooden chair seat for the leg. The seat is one inch thick, and you want the hole 3/4 inch deep.

First you position the work on the drill-press base and clamp it in place. Then lower the bit until it touches the work. Press the SET DEPTH key. You have now set the computer to the zero point for this particular job. The LED display will read 0.000.

Now check the speed-selection chart on the side of the drill press. For a 3/4-inch hole in wood, it tells you to put the tool's power shift knob in the HEAVY DUTY position and press speed selector key 5. So turn the power shift knob counterclockwise until the arrow points down. Then press key 5.

The drill press will start running, accelerating smoothly up to speed to avoid jolting your work out of position. Slowly feed the bit into the work. The computer feeds power to the motor according to load, helping to keep rpm constant. At the same time, it displays the depth of the hole continuously in 0.02-inch increments. When the readout reaches 0.74 inches (there is no 0.75 because it's an odd hundredths number), stop drilling.

If, for any reason, you want to check drill speed as you bore, simply press the DISPLAY RPM key. Then the rpm will appear on the display. Touch the DISPLAY DEPTH key and the depth readout will reappear. When you want to stop the press, touch the STOP key.

While it may sound complicated, it's really simple once you get used to it. And the controls are well thought out. The control panel, for example—keys and all—is made of a single sheet of plastic, perfectly sealed against dust and dirt. The speed selection and display command keys are fairly stiff; there's little chance of starting the press accidentally. The STOP key, on the other hand, is quite sensitive, so you can shut things down quickly.

Smart circuits

You'll rarely need to, however. The computer has some logic circuits that protect both you and the tool itself. Say, for example, you overfeed the bit while drilling metal, and the bit breaks through and binds. The computer will automatically shut the motor off and display error code "d" (instantaneous stall) on the LED panel. The motor will not start again until you depress the desired speed selector key.

If you try to start the press without removing the key from the chuck and placing it in its special holding pocket on the drill-press head, the motor will not start and the LED's will display error code L.

Should you overload the tool until the motor overheats, the LED's will begin flashing the code LOAD. At this point, you should press speed selector key 6 and allow the motor to run unhindered at full speed until it cools off and the LOAD display no longer flashes.

To test this feature, I put a squeeze-type wooden brake on the chuck and tightened it until the motor overheated. The LOAD display appeared and stayed on for exactly 30 seconds while the motor cooled.

The computer can also help you avoid mistakes. If you release the quill feed handle after drilling a hole and let the quill snap sharply back to the raised position, you may jolt the depth sensor off its zero point. If so, the readout will display error code "p," warning you to reset the zero point.

All this electronic wizardry is more than flash. The tool works, and it works well. The chuck runs smooth and true, with none of the wobble I've seen in some other small drill presses. The depth readouts are easy to read and dead accurate. To check them, I drilled a piece of wood with a brad-point bit until the tip barely broke through. I noted the depth readout, then drilled several more holes to the same reading. Each matched the depth of the first hole perfectly.

To check the motor's ability to maintain a constant speed under load, I chucked an oversize Powerbore bit in



Control panel of the computerized drill press includes the push-button plate and LED display. Here the display flashes LOAD, a code indicating that the motor is overheated—you may be overtaking the drill. The motor cools off quickly when it is run freely at high speed.

the press and fed it quickly into various types of wood, watching the rpm readout as I bored. A fast feed rate could cut motor speed about 200 rpm, but that's not bad. Only when I used a 1 1/4-inch spade bit in oak could I seriously bog down the motor. Remember, however, that a spade bit of that size is well over the maximum capacity of a tool this size (see table below).

Complaints? I have a few. The head is difficult to raise on the column. The handle on the chuck key hits the drill-press head, so you can't turn it a full 360 degrees. You have to be very careful to turn the power shift knob firmly into the LIGHT DUTY position or you will be greeted by a loud grinding of gears.

Finally, if you mount the press at normal bench height, the chuck is hidden by the head housing. For good visibility, you should mount the press up high, with the display panel at about eye level.

The Black & Decker Electronic Drill Press should be in stores by the time you read this. Price is expected to be in the \$180 to \$200 range. **ES**

SPECIFICATIONS

Max. diameter of workpiece	107/8"
Quill travel	2.90"
Rpm range	400-2,700
Max. depth (chuck to base)	83/4"
Drilling capacity (wood)	3/4" dia.
Drilling capacity (metal)	3/8" dia.
Chuck type	3/8" geared
Motor	3.3 amps, double insulated
Depth control	Visual according to readouts, or automatic by stop collar

Water-gel blanket

douses flames,
aids burn victims

An advanced gel serves as a portable fire escape and a soothing balm

By **SUSAN RENNER-SMITH**
ILLUSTRATION BY ROBERT RITTER

Smoke! You jump from bed and rush to the door of your hotel room. Through the peephole you see only flames. Undaunted, you flip open an orange canister and pull out a large blanket saturated with wet glop. Throwing the blanket over your head, you open the door and walk through the flames.

As you pass the next room, you see a fellow guest cowering behind the half-open door. You lift up the blanket and beckon him under. Together you reach the exit door, pull it open, and see that the way is clear.

Just then, you hear screams across the hall. You throw the blanket onto the fire, then pull it back toward you. This clears an eight-by-five-foot path through the flames. Several surprised people dash through to the exit, unharmed.

The above scenario illustrates only some of the applications of the Water Jel Fire Blanket, according to Cary Trilling, president of Trilling Resources Ltd. (250 E. Hartsdale Ave., Hartsdale, N.Y. 10530). The specially woven wool blanket, saturated with white, soupy-looking Water Jel, not only douses flames and shields people from heat and smoke, but also gives antiseptic first aid for burn victims.

Trilling has faith in Water Jel. To prove it, he's dipped his hands in the stuff, then plunged them into burning pools of gasoline. He's strolled between burning bales of hay and has

even sat down in the middle of a conflagration.

He's not the only believer.

"The stuff works," said Chief Robert Mauro of the Fairview Fire Department in White Plains, N.Y. "We bought three of the blankets." A number of fire and police departments have bought the blankets, as have the Coast Guard, Army, Air Force, and the New York City bomb squad.

The FDA has classified Water Jel as a medical device, and independent test labs have shown that it puts out even super-hot flames.

What is this stuff?

"Basically, it's a complex carbohydrate derived by extracting natural oils from various plants and by processing plant powders," Trilling said. He added that the water-based gel is thixotropic, so it will cling to the blanket unless shaken vigorously.

The gel blanket comes in two sizes: 2½ by three feet and five by eight feet. Each absorbs up to 13 times its own weight in gel, thanks to a patented open weave that creates tiny gel-trapping pockets.

The blanket has a three-year shelf life. "Not because of the gel," said Trilling. "That lasts indefinitely. But the added bactericides start losing their strength after three years."

The antiseptic gel makes the blanket a potent protection for burn victims. Lab tests show the gel prevents growth of five common microorganisms, including staph, says Trilling.

But infection isn't the only danger to burn victims. "Your normal, chemically treated fire blanket just smothers flames," said Trilling. "It can be 600 degrees under that blanket. The poor person boils in his own juices."

The Water Jel blanket both smother-

ers the flames and soaks the burn victim, preventing smoldering, Trilling claims.

"Then there's the soothing, cooling action from the menthol-type oils in the gel," said Trilling. "This takes the heat out of the burn and reduces pain, dehydration, and blistering." The treatment helps prevent shock, a major killer of burn victims.

And Water Jel's cooling action makes the blanket more effective for fire rescues than conventional fire blankets and even asbestos suits, Trilling says. Neither blocks heat as well as the gel. Intense heat hardens it, creating a thin skin on the blanket's outside that shields against heat and smoke. Meanwhile, the still-liquid gel inside acts as a heat exchanger, cooling the hot air that filters through the outer skin. The cooled air displaces hot air trapped under the blanket.

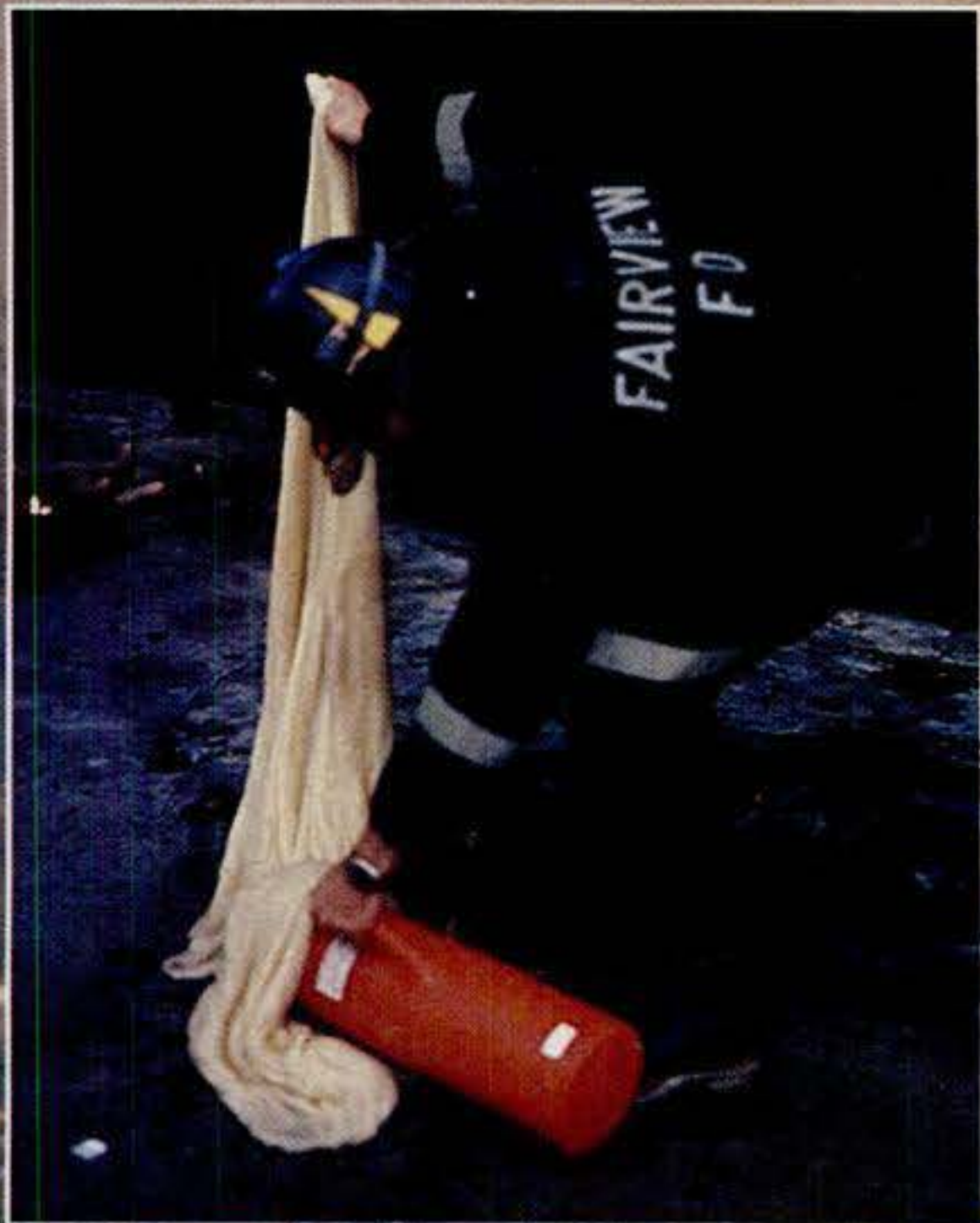
How long is the gel effective?

"It's hard to predict," said Trilling. "It depends on how hot the fire is. But the blanket I used on my last fire walk was still good afterward. We put out several burning dummies and an oil-drum fire with it, and the blanket was still effective."

Trilling added that the blanket won't fail without warning. If a wearer stops walking—perhaps to clear a blocked exit—heat will eventually build up under the blanket. But taking a few steps stirs up the air so it circulates through the gel again.

"You can do this several times," said Trilling. "But when it stays hot under there—that's the warning to get out."

The large Water Jel blanket costs \$250; the small one is \$100. "We're also working on a briefcase-size container," he said. "Then you can take it with you to crowded business conferences in hotels."

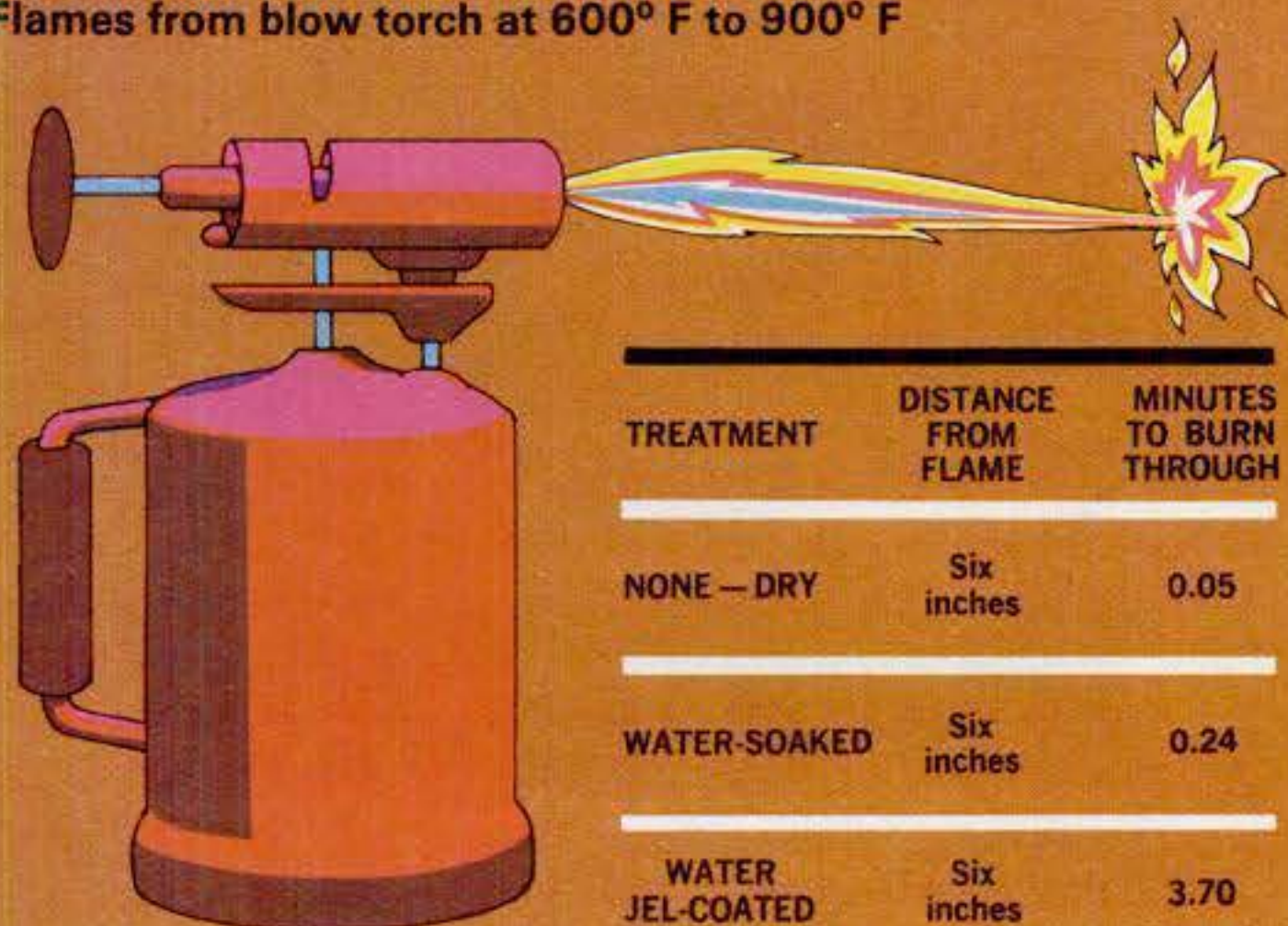


Ghostly shrouded figure (above) is actually a fireman protected from roasting by a unique fire-fighting blanket. Pulled from a

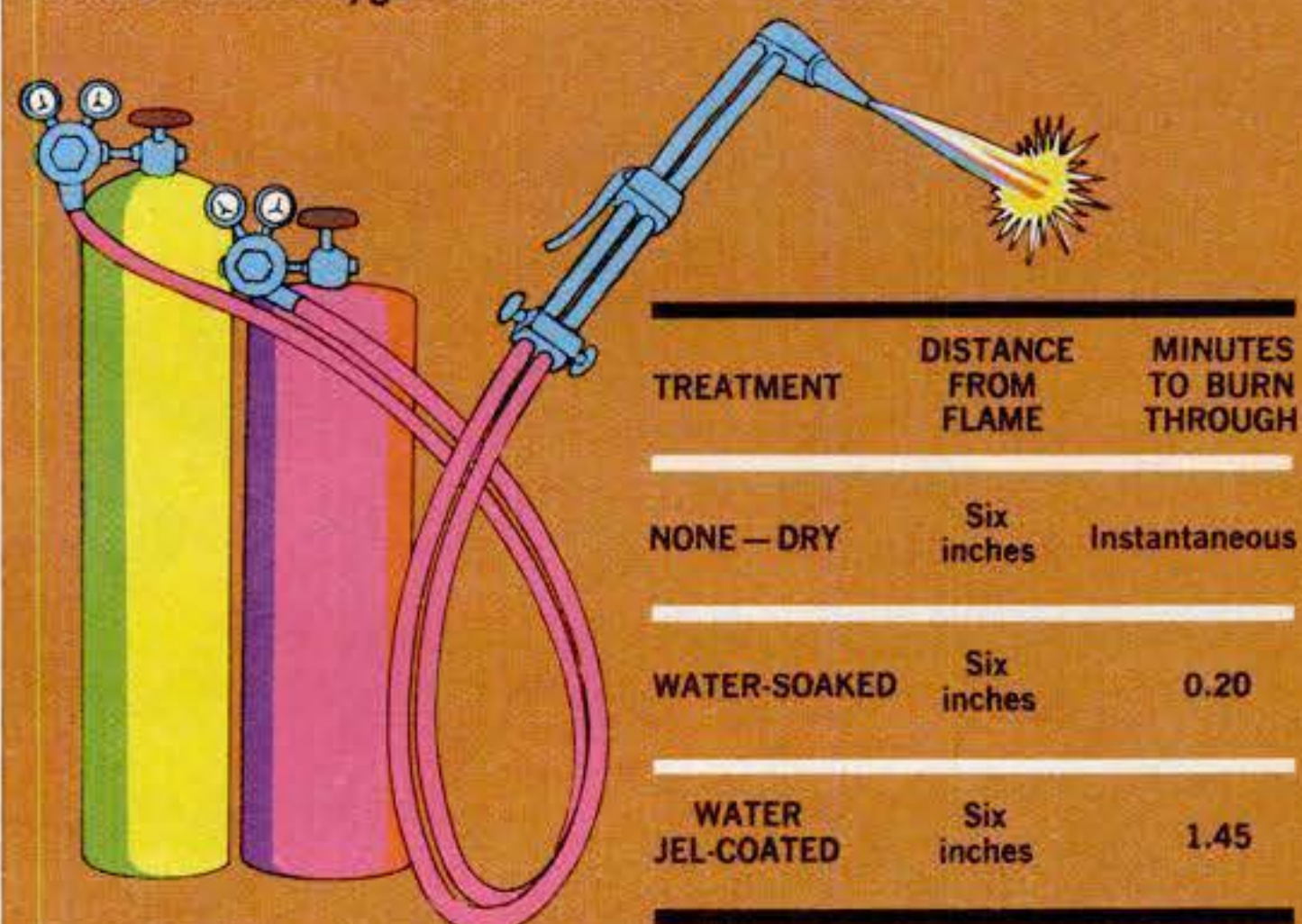
pop-top canister (inset), the gel-saturated blanket can be donned faster than an asbestos fire suit, and blocks heat longer.

Flame resistance of six-inch-square woolen blanket

Flames from blow torch at 600° F to 900° F



Flames from oxygen torch at 1700° F to 2000° F



The challenge of
ocean treasure.

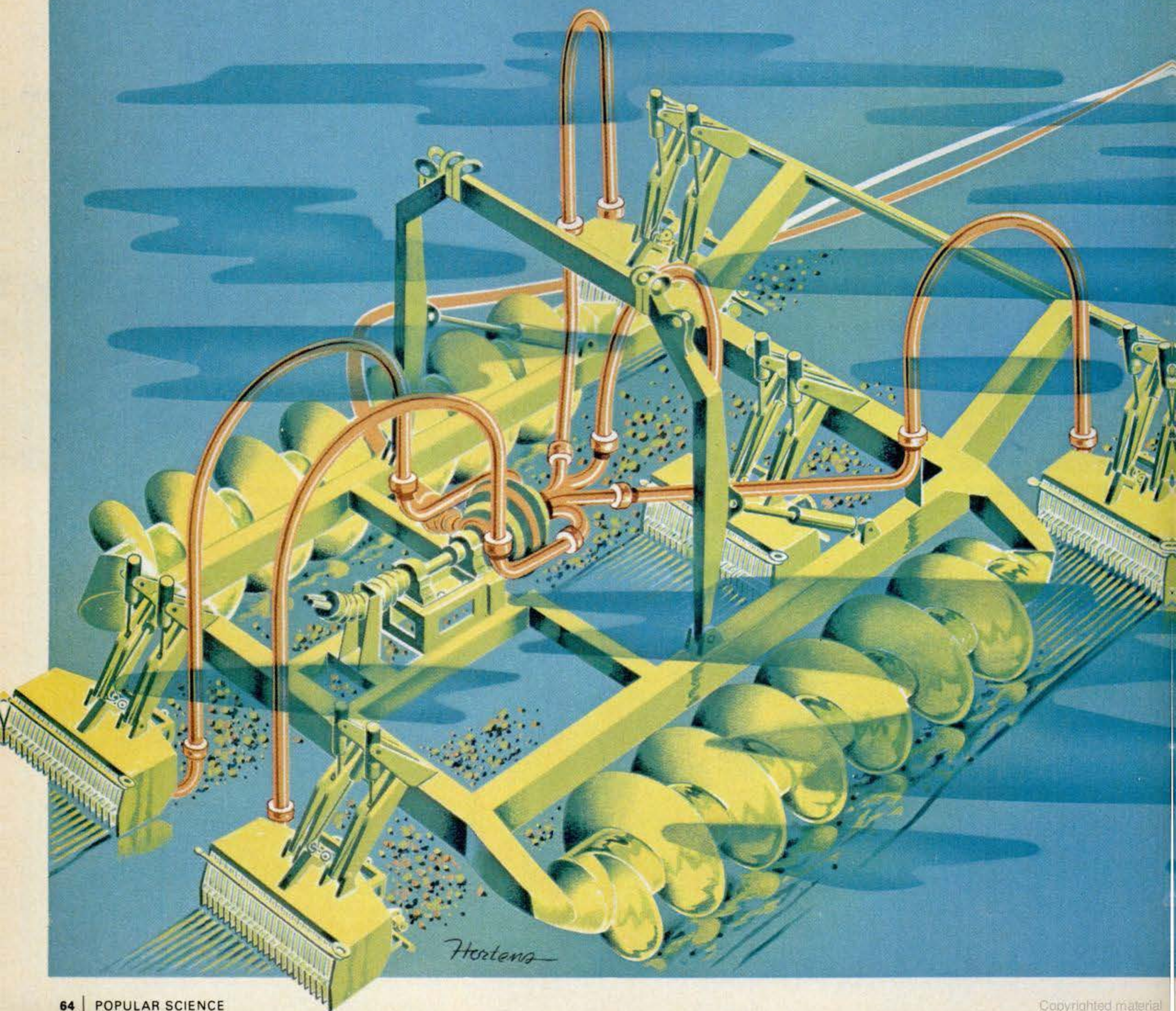
Deep- sea mining

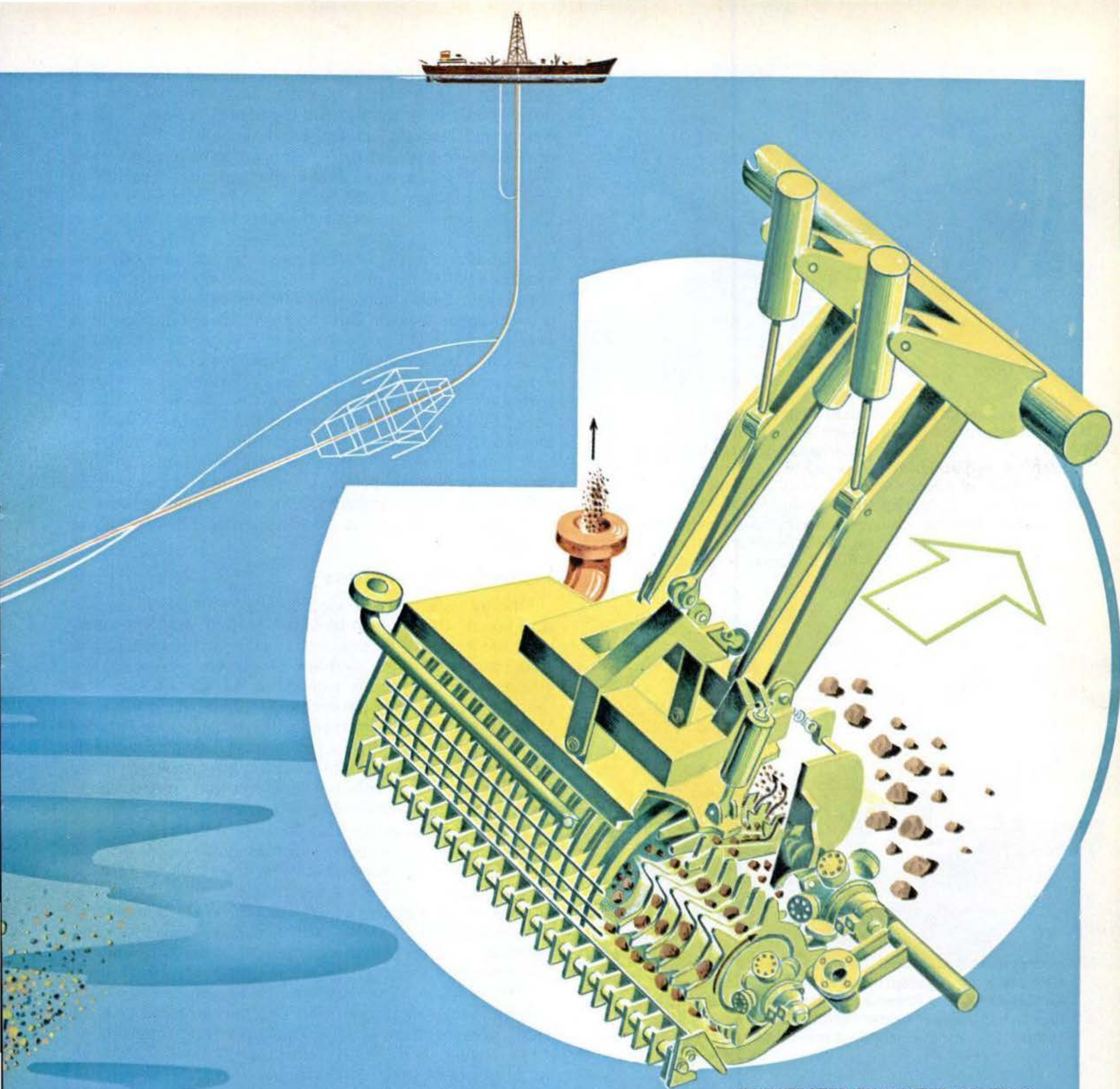
Mineral-rich manganese nodules are the prize. The technology to exploit them is untried; the politics unsettled

By **PETER BRITTON**

The deep-sea-mining ship *Lomis*, a 200,000-ton vessel with the maneuvering precision of a helicopter, comes to a dead stop some 1,700 miles south of San Diego in an area called the Clipperton Fracture Zone. As her powerful thrusters hold steady against a persistent current, sliding doors beneath the ship slowly open, exposing a 150-foot-long dredge head to the three-mile-deep abyss. The 250-ton machine is gingerly lowered on steel cables to a depth of 160 feet. Divers swarm about, checking connections, umbilical cables, a huge flexible hose, television cameras, lights, and sonar systems. A flotation

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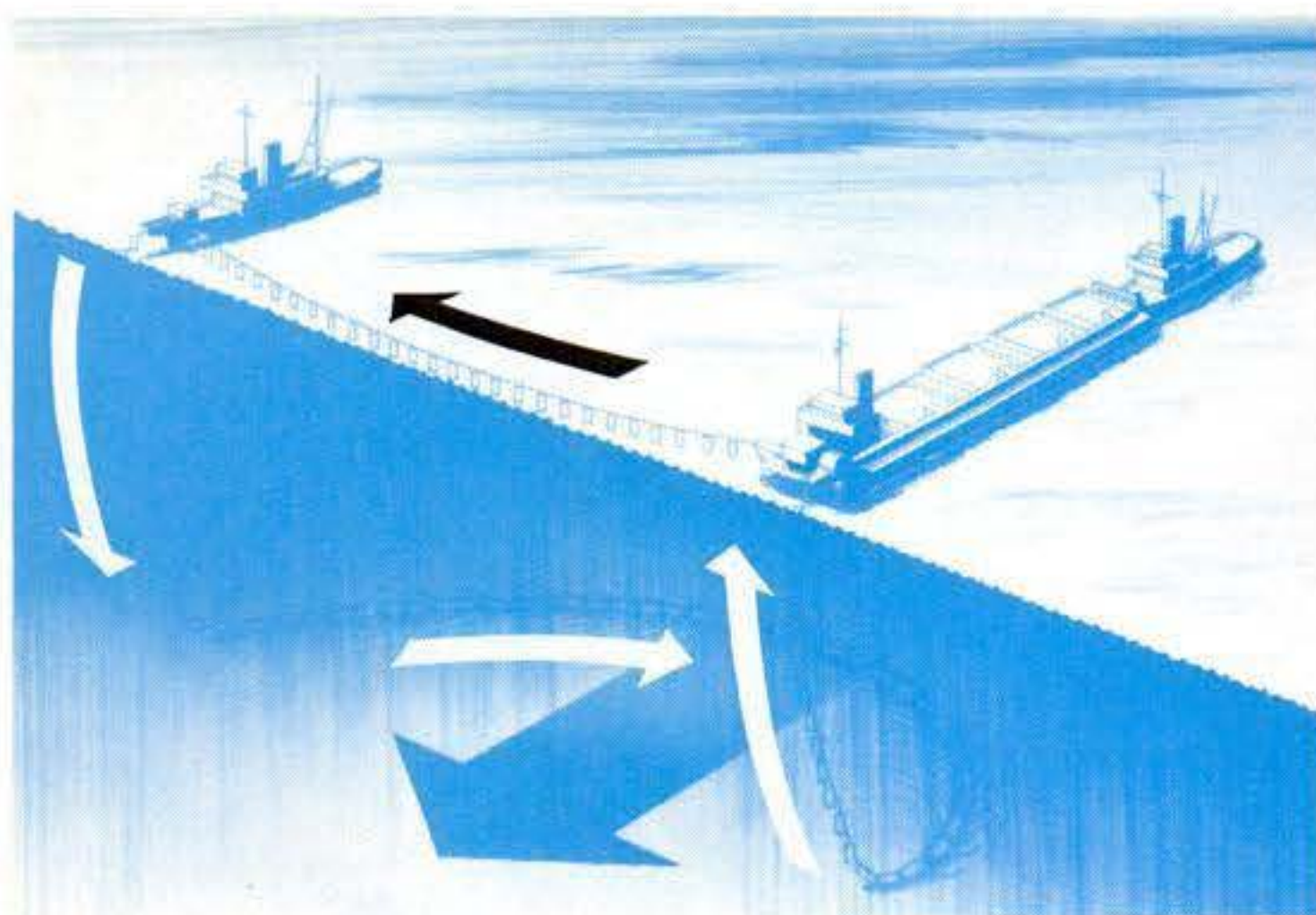
ILLUSTRATED BY WALTER HORTENS

Deep-sea-mining system designed by Ocean Minerals Co. uses a bottom-crawling dredge head to pick up, wash, and crush manganese nodules and pump them to an intermediate rig called a buffer. A specially designed mother ship receives the slurry and provides the operational control and maintenance support for the underwater machinery. Here's how the system works: The dredge head, equipped with sonar, lights, and television cameras, and controlled remotely from the ship, crawls slowly along the ocean bottom propelled by the inward turning of its Archimedean screws. As it moves, its nodule-pickup heads (inset) rake nodules and mud from the ocean floor. As

the nodules rotate on the tines, water jets clean them of mud. They pass to the crusher where they are ground into small particles. These fall into an enclosure beneath the crusher and are pumped, in a slurry, to the conduits (shown in red) at the end of the pickup heads. One pump serves all conduits.

From the conduits, the slurry is pumped through a flexible hose to the buffer, which is generally located about 75 feet above the dredge head. The hose and connecting cables are held above the dredge head by a flotation block (not shown). The buffer holds the slurry temporarily; it also houses all the equipment not needed on the dredge head itself. The buffer is connected to

the ship by a rigid pipe. In the design illustrated, the slurry is raised to the ship through the connecting pipe by a system called an air lift: An air line from a compressor on the ship injects air into the pipe at a point about 5,000 feet below the surface. The air lowers the density of the fluid inside the pipe from the injection point to the surface. The total weight of the fluid inside the pipe, from top to bottom, is then less than the weight of the water outside. Thus, outside water pressure pushes everything in the pipe up to the surface. (Electric pumps or pressurized sea-water lifts could also be used to raise the slurry.) The nodules are transferred to large cargo vessels and hauled to shore.



Continuous-line-bucket (CLB) system of deep-sea mining is being developed by a Japanese company. It uses five-ton-capacity dredge buckets attached at 80-foot intervals to a 10-mile loop of heavy polypropylene cable. The loop runs between two ships (which move on a parallel course a half-mile apart); its lowest section drags on the bottom, and the buckets scoop up nodules and sediment. One ship hauls in buckets of nodules and mud and the other returns the empty buckets to the seabed. A French CLB system uses one ship.



Pilot-scale mining ship, the R/V Deepsea Miner II, is the test ship for Ocean Mining Associates (also known as the Deepsea Venture Group) of Gloucester Point, Va. The ship has successfully completed a proof-of-concept mining test.

block is deployed, followed by another huge piece of equipment called a buffer. The whole works is lowered—step by step. Finally, three days later, the dredge head, buoyed with foam to near weightlessness, touches down softly on slime that is covered with potato-size lumps. In pitch darkness and under 6,600 pounds per square inch of pressure, the dredge head's lights come on and the massive screws turn. The bizarre device begins crawling forward and gobbling up the lumps.

This, at least, is a scene that Conrad Welling, senior vice-president of Ocean Minerals Company (OMCO), and his colleagues elsewhere in the fledgling deep-sea-mining industry hope to see as front-page news—and the sooner the better. OMCO's monster miner (opening pages) is one of several systems designed to pick up as much as 15,000 tons of manganese nodules a day and hoist them to a surface ship—to be carried to processing plants on shore. The goal: badly needed cobalt, copper, nickel, and manganese.

Since 1873, when the research vessel HMS Challenger first discovered curious black lumps in a trawl net, science

has been aware of manganese nodules and the valuable minerals they contain. As much as 100 billion tons of nodules may litter the floors of the world's oceans. To date, commercial interest has centered on some 15 billion tons in the Pacific. Marne Dubs, director of ocean resources for the Kennecott Group, one of several companies involved in deep-sea-mining research, puts it simply: "The nodules are the most significant untapped source of raw materials in the world."

A handful of multinational consortia, including Kennecott and OMCO, has already spent around \$300 million on research and development of machinery to capitalize on this untapped wealth. But the problems are enormous in every arena—legal and political as well as technological.

"We're winding down the final stages of research and development now," says Welling, a former space expert with Lockheed Missiles & Space Co. "We've used both ancient and space-age technology, from the Archimedean screw to the finest computers, to fashion what we feel is the best system to operate in these worst of conditions. Now we're ready to build prototype machines and go commercial. All we need is about \$1.3 billion, the legal go-ahead, and eight to 10 years to set ocean-mining industry's gears in motion."

Technological problems

Finding the nodules is possible using an array of modern equipment: depth recorders; sub-bottom profilers; sampling devices; seismic profilers; sonar; still photography in stereo and wide angle; and low-resolution, slow-scan television. Relocating them depends on navigation satellites that can direct a vessel to within 1,000 feet of a given spot. Mining ships will be equipped with thrusters commanded by on-board computers electronically linked to acoustic transponders on the bottom. This system enables the ship to stay in one spot relative to the bottom regardless of wave, wind, and current conditions.

Locating and keeping track of the nodules is one thing. Getting them to the surface in commercial quantities is quite another. Some experts liken that task to sucking grains of sand up a straw from a bed of mud to the top of a skyscraper—at night, in a high wind. Several schemes have been devised to do it. All are unwieldy, expensive, and untested on a long-term commercial basis. One method under serious investigation is the continuous-line-bucket system, which is being developed by French and Japanese concerns (drawing, upper left). This system could be built small, and therefore at somewhat lower cost than others. It is strong and easily maintained, and has high mechanical efficiency. And it should work in high seas. But it is awkward, slow, and apt to get stuck in the mud. Also, rope strength and speed in hauling the buckets aboard ship may limit production to about one million tons per year per unit. Furthermore, the continuous-line-bucket system is untested, even on a pilot scale.

Most prospective sea miners are developing seabed collectors or dredge heads of varying designs, such as the OMCO system illustrated on the opening pages. These pick up nodules, crush them, and transfer them via a pipe to the mother ship.

Another proposed method of nodule raising is by a mining shuttle, either manned or remote-controlled. Deemed too sophisticated and expensive now, the shuttle is nevertheless under consideration by a French ocean-mining company, Afernod, and may be feasible in the future. In one variation, a dynamically stationed semisubmersible is the mother ship. A set of eight shuttles goes back and forth to the seabed, spending less than eight hours on a round trip. The shuttles are loaded at the surface with "dead" ore or tailings, which pull them to the bottom. There, the tail-

ings are jettisoned during the dredging process. The shuttles return with several hundred tons of ore, and dock 130 feet below the surface in the submerged portion of the platform. Fifty tons of batteries would supply the power. A daily production rate of 6,000 tons could be achieved, and nodule processing might be done at sea.

There are problems with all the proposed systems. The nodules lie on sedimentary mud that is more viscous and tenacious than Georgia's red clay, and it can rapidly clog machinery. Also, unpredictable outcroppings and abrupt scarps can stall sleds and damage dredge heads. Resonances can arise in the pipe string. Too much flexing and bending can cause pipe fatigue. And power requirements are high for all systems. Says Kennecott's Dubs: "The basic engineering is done, but we're on the frontier of the technology. It has yet to be proved that the systems can work for months at sea without stopping. That's the challenge."

As with the rest of the deep-sea-mining industry, the final leg—processing the nodules—has yet to be developed on a commercial basis, though several pilot plants have been started. Present plans call for mined nodules to be carried by large cargo ships to processing plants on land. Dubs believes that the processing will account for more than half of the operation's total cost. The reason: A new chemistry is needed. "There are no ores on Earth like manganese nodules," he says. "The elements of interest are locked in a complex ferromanganese compound that has to be chemically processed to break up its constituents."

Companies have been investigating two basic extraction approaches. One is hydrometallurgical, which uses either ammonia, sulfuric acid, or hydrochloric acid to put the desired metals into solution (leaching) and then remove them. The second is pyrometallurgical: The nodules are smelted and separated into slag, ores, and matte (a mixture of metal and its oxides). The matte is then leached and the metals removed from the solution.

Environmental questions

Not surprisingly, there is concern about the environmental effects of deep-sea mining. To investigate the

potential problems, the National Oceanic and Atmospheric Administration (NOAA) began the Deep Ocean Mining Environmental Study in 1975. The study's major concern: What happens when sediment, frigid bottom water, and macerated bottom matter are dumped overboard at the surface? The nature and rate of dispersion of the resulting plume have been studied. The long-term effects on the organisms that form the base of the oceanic food chain—the phytoplankton and zooplankton—are still under study. But Amor Lane, director of NOAA's Marine Minerals Division, says, "We see no serious environmental impediment now to the start-up of at-sea mining. We also plan to monitor long-term demonstration-scale mining, which will necessarily precede commercial mining."

The study is also examining environmental aspects of nodule processing. The onshore nodule refining will leave wastes of solids, hydrous slimes, and sludges. Various treatment and containment methods are under investigation, but the answers are not yet in on how best to handle the wastes. Pilot-plant testing has just begun.

Legal and political problems

But at this point, the major obstacle to deep-sea mining isn't environmental, technological, or even financial. It's a question of who has the right to what, and who will regulate worldwide deep-sea mining. Industrial countries and the third world are vigorously competing for rights to this "common heritage of all mankind," as the United Nations calls the seas' bounty. The UN's Law of the Sea Conference has been considering this complex problem since 1973, and was expected to conclude a treaty at its session in New York last March and April. But the Reagan administration demurred, pending a policy review. So for now, the patents are issued but the industry is pending.

Says Marne Dubs: "We've done all the simple things. The next major step is to build a prototype mining ship and operate it for several months. Eventually, deep-sea mining will be a very important source of metals. The only thing that could stop it is not technology or the marketplace, but a screw-up by governments." [5]

Manganese nodules—a rich mystery

Ferromanganese nodules are small, rock-like lumps that litter ocean floors around the world. They vary from red-brown to jet black, from crumbly to hard, from a half-inch to six inches in diameter, from rough to smooth. In some places they are sparsely distributed; in others the seabed resembles a cobblestone street.

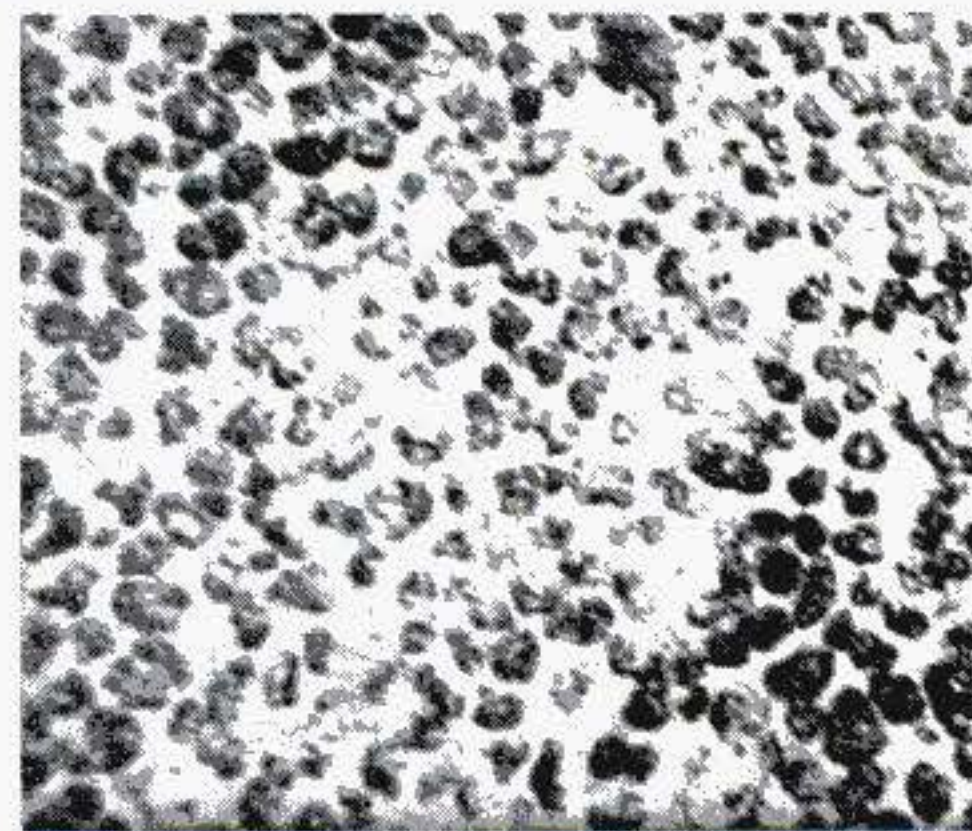
Contained within these inelegant concretions are some 30 minerals, several of which may soon be scarce and others whose price could be driven up by the exporting countries. Deep-sea miners are primarily after four metals: copper (1.25 percent of a high-grade nodule), cobalt (0.25 percent), manganese (25 to 35 percent), and nickel (1.5 percent). All four are critical. Steel cannot be made without manganese, and 98 percent is imported. Nickel is used in making stainless steel; 70 percent is imported. Cobalt is used in cancer treatment and in the manufacture of high-temperature alloys for jet engines; 98 percent is imported. Even 15 percent of our copper is imported.

Manganese nodules are cloaked in some tantalizing mysteries. For example,

no one knows for certain how they are formed: The minerals could be washed from land, but the nodules don't occur where there is continental runoff. Another theory involves fallout from volcanic activity, but the distribution pattern is wrong. A more likely theory is that some biological interaction at the surface marshals the metals, for the plankton belt nearly coincides with nodule distribution.

Some experts believe that microscopic plants extract metals from ocean water. The metals would then be incorporated into the food chain, fall to the ocean floor as excrement, and grow, often encasing a foreign object such as a shark's tooth, coral, clay, or basalt. Still another school believes that an unknown set of environmental factors—perhaps slow sedimentation, high oxygen content, limited acidity, and electrolytic potential—could cause metal ions in sea water to cling to a nucleus. Whatever the process, it is lengthy; dating techniques indicate that a nodule grows only one millimeter every million years.

To understand nodules better, Scripps Institute of Oceanography is about to undertake an experiment, as part of a National Science Foundation project, to



study the sediment-water interface at 15,000 feet. This study may also provide clues to another great nodule riddle: Why are so few buried in sediment? Up to 130 feet of sediment would have accumulated during the 10 million years needed to achieve normal nodule size. But the nodules all appear to be on the seabed surface. Some scientists think that small, bottom-dwelling organisms constantly nudge them upward. Or organisms may live in tiny corridors inside the nodules and keep them buoyant. Or perhaps bottom currents sweep them clean. But none of these theories has been proved.

Solar sandwich

heats fast,
cools slowly

A collector coating that comes on a roll is a one-way street for heat

By DAN RUBY

Getting solar energy into a building is easy. Keeping it there is not. Heat always flows from a warm place to a cold place, so a major share of the energy that shines into a house during the day sneaks right back out at night. Compounding the problem, most surfaces that are effective energy absorbers (flat-black paint, for example) are also good radiators.

Solar designers have tried many methods to reduce night losses, in-

cluding multiple layers of glazing and various kinds of movable or blown-in insulation. Double and triple glazing cuts thermal losses, but it also reduces solar gain. Insulation schemes tend to be expensive and inconvenient. An ideal solution long sought by passive-solar designers: a coating material that acts both as a good absorber and a poor radiator.

Such selective surfaces have been used in some active solar systems, but now Berry Solar Products has introduced the first such coating for passive collectors. Called SunSponge, it comes on a roll with adhesive backing for easy application to Trombe or water walls.

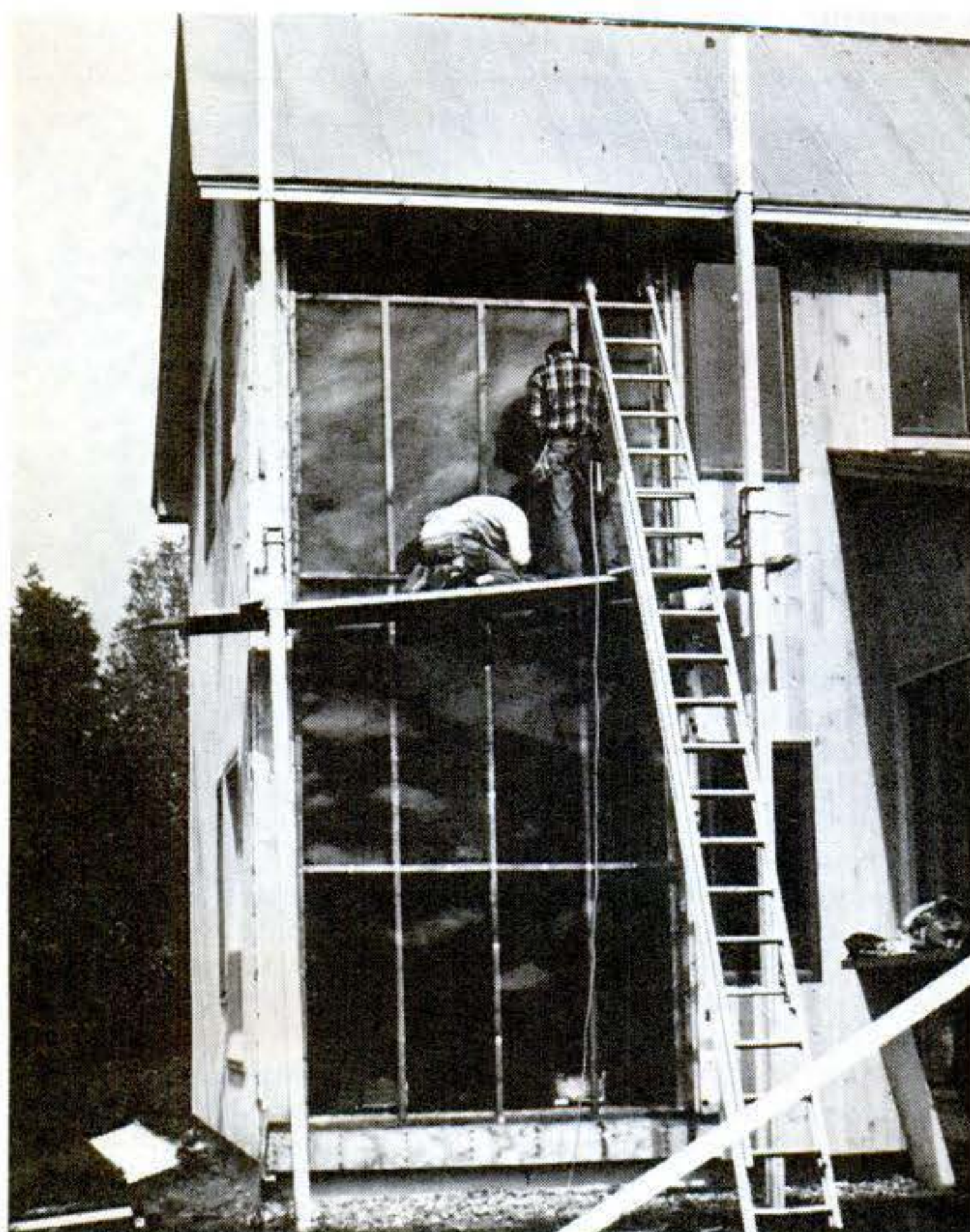
SunSponge is a four-mil-thick sandwich composed of black chrome elec-

troplated on copper foil with a nickel interface to inhibit corrosion. The surface is made up of microscopic spikes of chrome and chrome oxide spaced so that they admit short-wavelength solar radiation but block longer-wave thermal radiation. The result, claims Berry, is absorptivity of 94 percent and emissivity of only 10 percent.

The material has been tested extensively both for performance and durability. A study at Los Alamos Scientific Laboratory found that the performance of a single-glazed Trombe or water wall was boosted by about 60 percent when SunSponge was used instead of black paint. On double-glazed walls, performance was improved by about 20 percent. The study also tested SunSponge against Bead-wall night insulation [PS, July '76]. The insulated wall cooled more slowly at night but the SunSponge wall reached a higher temperature during the day. The overall result was a 10-percent advantage for the selective surface.

Durability testing by several independent labs showed that the coating maintained its optical properties after long-term exposure to high heat and humidity.

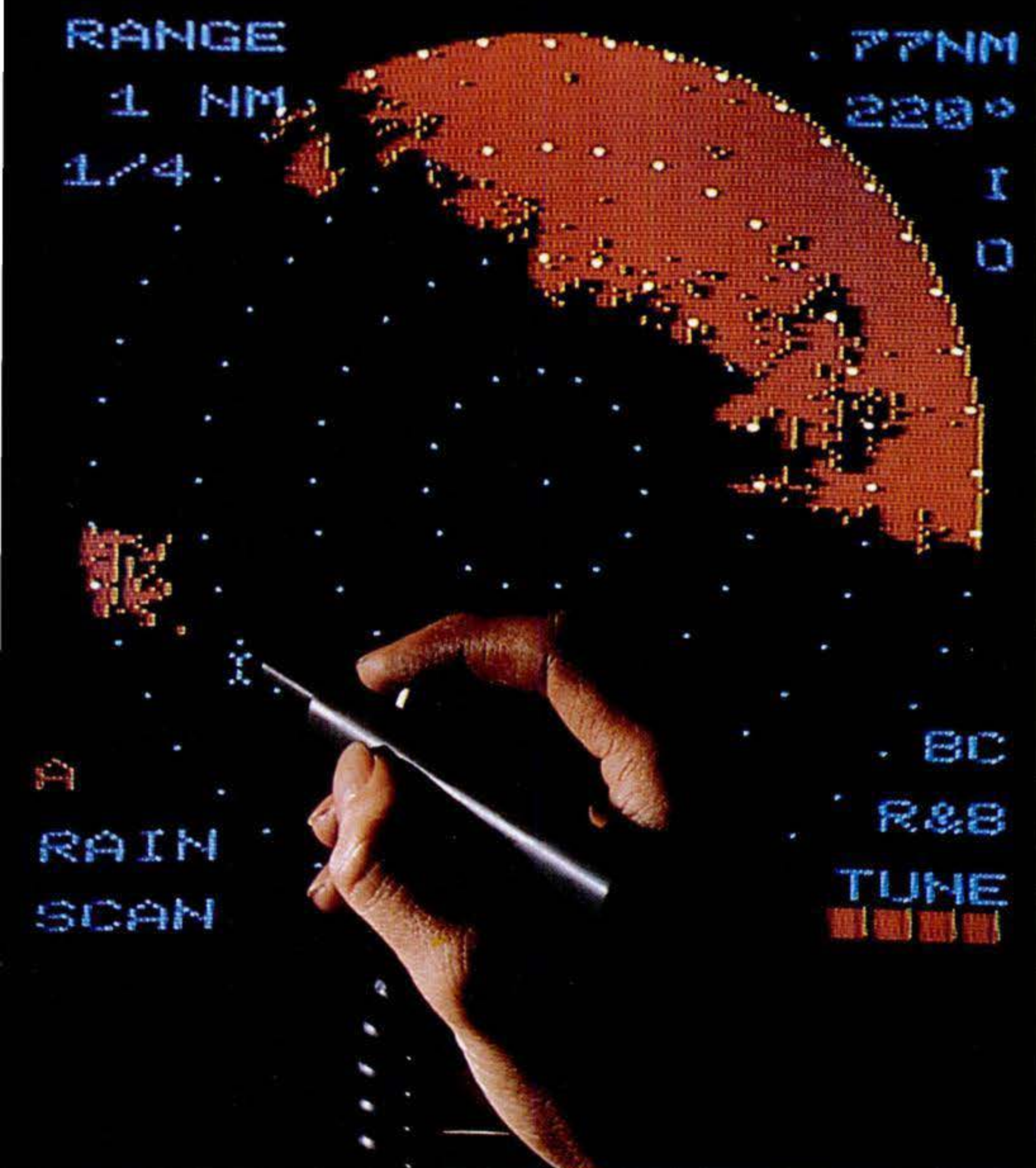
Right now, Berry (Box 327, Edison, N.J. 08817) is selling mainly to architects and builders, but it may branch into the do-it-yourself market. Price: about \$1.75 per square foot for a minimum order of 100 square feet. **ES**



SunSponge selective surface has been installed on passive-solar demonstration homes by Detroit Edison and Pennsylvania Power and Light. Proper installation is crucial; bubbles or crinkles in the aluminum-foil-like material will hinder performance. Black-chrome surface is covered by plastic film to prevent contamination by perspiration and dirt during installation. Surface of the Trombe or water wall may have to be smoothed with filler material to ensure a strong bond.

Memory radar

—no-fade picture on your color TV



Trim Omnicolor radar console (left) uses any TV set for full-color display of 360-degree area scanned by the antenna (above). Blue dot at center represents ship; orange defines land. Range code at upper left says area scanned is one nautical mile and range rings are 1/4 nautical mile apart. The light pen moves the X-shaped cursor around the screen. Data at upper right says cursor's current position is 220 degrees off ship's bow and 0.77 nautical miles away. "Rain" (lower left) shows clutter suppressors are on so radar can see through the rain.

Marine radar gives a crisp, full-color display—without a viewing hood

By **SUSAN RENNER-SMITH**

Imagine piloting a boat into a crowded marina in pea-soup fog—with your head stuck inside the viewing hood of a radar unit. As you squint through a magnifier at the phosphor-coated view screen, you try to remember the position of each blip before it fades from the screen. When you pull your head out to steer, it takes a few seconds to adjust your eyes to the light. By that time you must poke your head back under the hood again.

With Wesmar Marine's new micro-processor-controlled radar, the scenario changes dramatically. Gone is the impractical viewing hood—in fact, the whole bulky radar unit is missing. Instead, there's a three-by-12-by-14-inch console that connects to any color TV set or monitor.

Best of all, the display does not fade from the screen as the antenna sweeps through each segment of its circular scan. Instead, the radar's memory keeps the full 360-degree picture on the screen. With every six-second scan, the computer updates the position of each object relative to the boat. A skipper can now watch an object move across the screen instead of trying to memorize its position between scans.

To find out how far away anything shown on the display is from his boat, the skipper touches the screen with a light pen. Instantly, the computer calculates range and bearing and displays it on the screen.

The light pen also arms the intrusion alarm. Usually a costly option, this alarm is standard on the new Omnicolor radar. To set it, the skipper touches I and O on the screen (for inner and outer), then traces over any two range rings (see photo). Any object entering the guarded zone triggers a loud electronic beep, while a large A flashes on the screen.

The radar can scan 10 different ranges—from 1/4 to 80 nautical miles, so is usable for both long-range and coastal navigation, and for tight maneuvering in crowded anchorages.

The basic Omnicolor SR1000 unit costs \$2,490. That price includes console and a 2½-ft., 18-lb. scanner antenna. It doesn't include the TV set or the light pen, which costs \$200 extra, according to Wesmar (Box C19074, Seattle, Wash. 98109). To get the largest, 6½-foot, scanner (which gives sharper resolution) you pay \$1,300 more.

De Lorean's
stainless-steel-clad
**high-tech
sports car**



Under the wolf's clothing lies a safety car for the real world

By ED JACOBS

DUNMURRY, NORTHERN IRELAND

It was quite a sight. Walking out of the assembly building, I was confronted by a sea of gleaming, brushed-stainless-steel shapes: a parking lot full of De Lorean sports cars set under a sparkling blue Northern Ireland sky.

I was on a visit to the De Lorean factory, where I talked to engineers, watched cars being assembled, and had the opportunity to evaluate several early production models on a track and open road. What I found was impressive: ultramodern facilities; newly perfected manufacturing techniques; and well engineered automobiles with exceptional crash and corrosion protection plus the comfort and handling of first-rate sports cars.

Before going further, however, a bit of background might be helpful. The car is the brainchild of John Z. De Lorean. In an industry where wearing other than a conservative suit can get you branded a maverick, De Lorean is a virtual insurrectionist. After turning around both the Pontiac and Chevrolet divisions of General Motors and becoming heir to the firm's presidency, he abruptly quit and went off to start his own car company—something no one in America has done successfully since Walter Chrysler.

After funding was secured from the British government to build an assembly plant in Northern Ireland, things really took off. In less than two and a half years De Lorean created a fully tooled, 700,000-sq.-ft. manufacturing complex to produce his car.

When first proposed—in conjunction with the Allstate Insurance Co.—the De Lorean was to be a two-seat safety car capable of protecting its occupants in 50-mph crashes. It was also to be the "ethical sports car," because it was to feature extensive protection against corrosion, good fuel economy, and tenacious handling.

Although highly refined, the car is still basically as proposed. It has a fiberglass body incorporating special crash-protection members, a stainless-steel outer skin, a modern backbone-type chassis developed in cooperation with Lotus Cars, and an aluminum-alloy V6 engine.

The most important element of the De Lorean is its heavy emphasis on safety. Strategically placed throughout the car (see diagram) are 10 polyurethane-foam "crush structures" de-

signed to progressively soak up collision forces in frontal and side impacts, as well as roll-over crush loadings. The foam itself is remarkably light and can easily be flaked apart with bare hands. But try to crush it and you will find it surprisingly strong.

For added protection, the gas tank is mounted on the car's center line in front, below the spare tire (another crush structure) and between two forward extensions of the frame. The tank is molded from splinter-resistant plastic for even more protection.

The sloping windshield is located well away from driver and passenger, and crushable polyurethane bumpers protect both the car and pedestrians.

Rounding out the major safety highlights are excellent handling, steering response, and braking characteristics—all intended to help you avoid an accident in the first place. Here, a careful balance had to be found between response and twitchiness, says chief engineer Mike Loasby. "Response usually goes with twitchiness, and we didn't want a twitchy car."

One major potential safety deficiency has been repeatedly shouted by critics of the De Lorean. Because it has gull-wing doors, which open up instead of out, they've claimed, you'd be trapped in the car if it should roll over. But as in most cars, the glass in the De Lorean is designed to be kicked out in an emergency. Beyond that, in the inverted position the door and ground form a lever-and-fulcrum arrangement with considerable mechanical advantage. Little effort is needed to push the door open 15 inches or so to escape.

Those doors, incidentally, are counterbalanced and regulated by gas struts and stainless-steel torsion bars given 13 twists while immersed in liquid nitrogen, a process developed by Grumman Aerospace.

Coup de grace for corrosion

Second only to the safety features are the extensive anti-corrosion measures. The fiberglass components of the body understructure won't corrode, of course, nor will the car's brushed-stainless-steel exterior.

The mild-steel chassis is protected from corrosion by hot-dipping it into epoxy powder, which melts and flows uniformly over the entire surface and into compartments. Rear-suspension members are treated the same way, according to Mike Loasby, "because their box shape prevents plating them properly inside and out."

De Lorean's manufacturing technique is particularly interesting. He's using the vacuum-assisted resin-injection process Lotus developed for

its limited-production cars, but has reworked it for mass production.

First the fiberglass-wrapped foam crush structures are positioned in the body molds along with the layers of fiberglass for the body shells. Then the molds are clamped together, vacuum is applied, and 160-degree-C resin is injected. Microprocessors control the transfer, heating, mixing, and delivery of the resin. It's rather like computerized cake baking on a grand scale. The various resin formulas are even called "recipes."

Then the upper and lower body halves are bonded together, just like building a huge model car—even down to the familiar styrene odor. Finally the bodies are cured in an oven with three distinct temperature zones prior to precision fettling (trimming) by a 60,000-psi water jet.

The car's engine is a 2.8-liter variation of the aluminum V6 jointly developed by Peugeot, Renault, and Volvo. In its most exotic version, the engine is Renault's 530-hp, turbocharged 1.5-liter Formula I racing engine. For the De Lorean, the engine has single overhead camshafts and Bosch K-Jetronic fuel injection. It develops 135 hp and is EPA rated for about 30 mpg highway. Two transmissions are available: a five-speed manual and three-speed automatic.

Tires play an important role in both the design and planned handling of the De Lorean. Two different sizes are used: 195/60HR14 at the front and 235/60HR15 at the rear. That's a bit unusual, but not unique. What is special? Not only were changes made in the car to work well with the tires, but De Lorean had changes made in both the tire's compound and construction to work better with the car.

While in Northern Ireland, I had the opportunity to drive and evaluate five early production cars. Overall they were impressive, although each did have its small imperfections, some of which were common to all. I was assured by spokesman Peter Moore that fixes for most were in the works.

On the road the De Lorean is reassuring, responsive, and enjoyable, but it could get you into trouble—with the law. For an exotic sports car it is neither extremely quick (zero to 60 mph in the nine-second range) nor exceptionally fast (top speed around 125 mph), but it is unusually deceptive about how fast it is traveling. What's more, like a thoroughbred horse, it loves to run, regardless of the type of road. Several times I found myself unintentionally and placidly cruising on the high side of 70 mph, even on narrow, undulating two-lane roads

Continued

near Giant's Causeway in County Antrim. I'm not the only one to have experienced that; watch your speed.

Steering response is quick and direct, with no power assist needed. Handling is very good, with tenacious cornering ability. The tail of the car does move to the side slightly during hard cornering (as though the side-

walls of the rear tires were flexing), but after that the car is rock-solid. Although the tail movement isn't a problem, it might alarm an inexperienced driver. That's not entirely in keeping with the philosophy John De Lorean expressed several times during my visit: "We want the car to be lively, but not intimidating."

The ride is firm but by no means stiff, and I found the car both comfortable and relaxing. The bucket seats (leather) are nicely sculptured and hold you securely during hard cornering. Overhead, rectangular indentations in the door provide additional head clearance.

The cockpit is well laid out in terms of placement of pedals, shifter, and steering wheel, which telescopes and is adjustable for height. The instrument panel is well equipped, and all gauges (except the top of the oil-pressure gauge) are readily visible.

Now the negative side: Above 65 mph all five cars developed a distinct, high-pitched whistle. The markings for the heater and air-conditioner controls were impossible to read in daylight, even though backlit. The digital clock lies nearly flat on the console, and the bottom half is obscured. Some rocker switches are placed on the console under your elbow and are frequently bumped during shifting. And none of the heaters was especially effective. Overall, though, the cars were still quite good.

Things aren't going to be easy sailing from here for De Lorean. For one thing, competition will be tough. The car's prime competitor, the Corvette, will be completely redesigned in just 14 months.

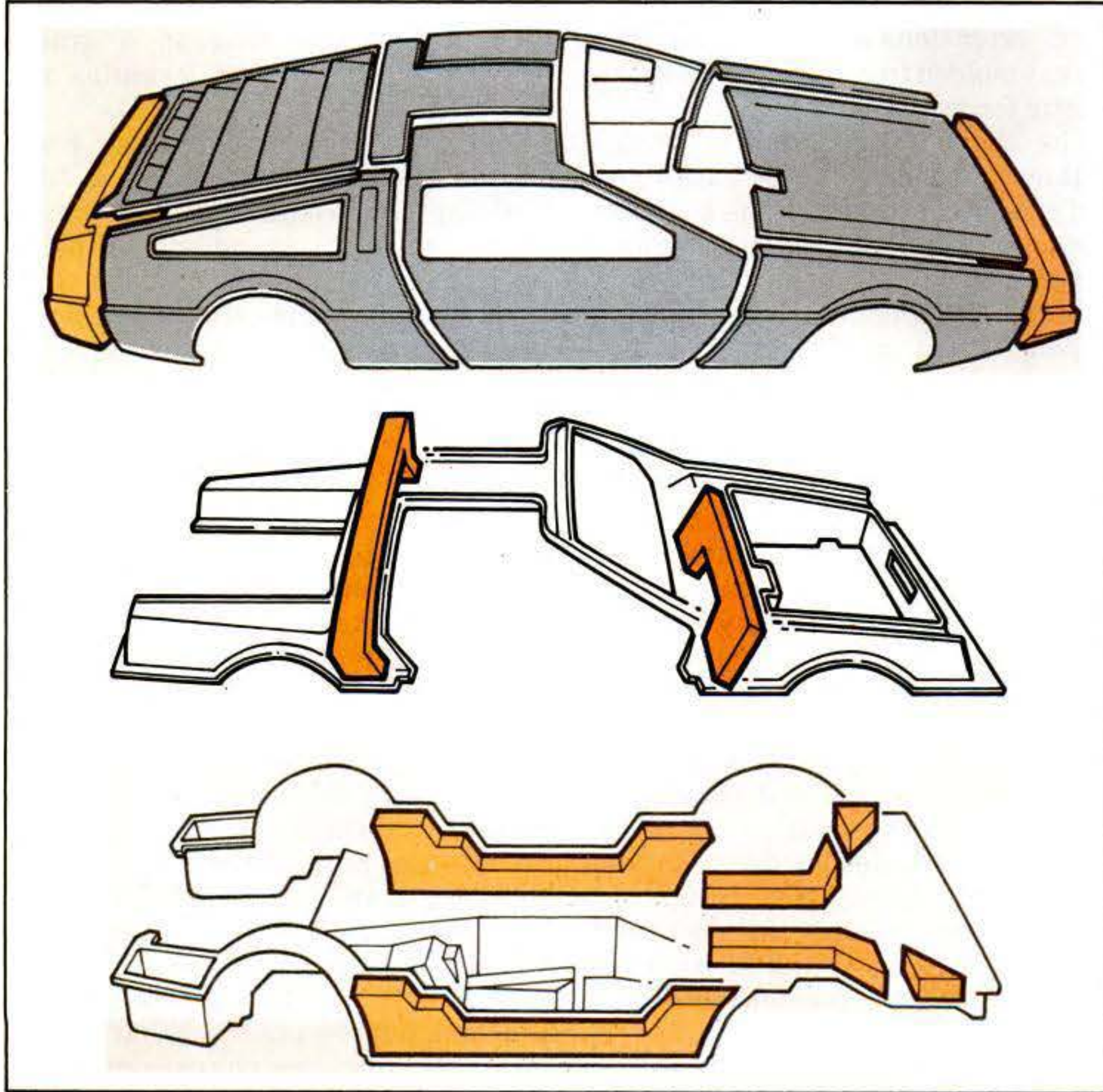
Then there is the sporadic religious strife in Northern Ireland. While the big work force has a great spirit and gets along well, there is no guarantee that the company might not somehow be caught up in the conflict.

The people do see a lighter side to the situation, though. When chief engineer Loasby and I were walking down the production line, he pointed to a steering column and chuckled, "You should have seen the fun we had trying to get some of those through security at Heathrow." With their thick shafts and expanded-metal crush sections, at first glance they'd look like a sack of machine guns!

The De Lorean engineers are looking beyond the problems. A more efficient cylinder head is under consideration. A sportier suspension package will soon be available. In September an optional 280-hp twin-turbocharged engine will go into production. Then, later, there will be a four-seater, currently planned to maintain a strong family resemblance. And construction from advanced composites like graphite-epoxy or Kevlar is a possibility.

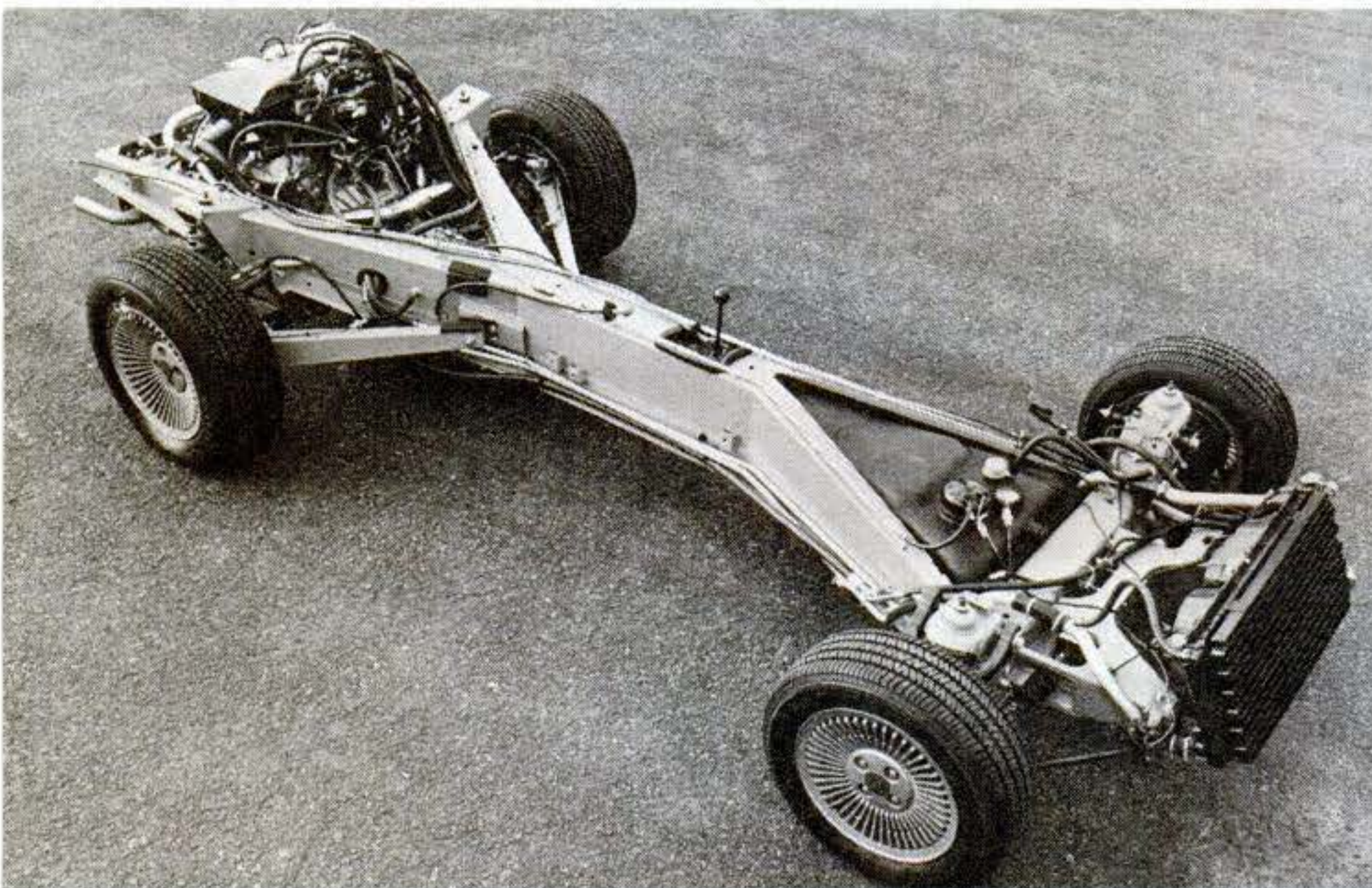
Stay tuned, we'll be following those developments, of course, and will have a full test of the De Lorean shortly.

You will be able to buy the De Lorean in this country at the time you read this—for about \$25,000. **ES**



An exploded view reveals the De Lorean's body construction. Bumpers, window louvers, and stainless-steel panels are at the

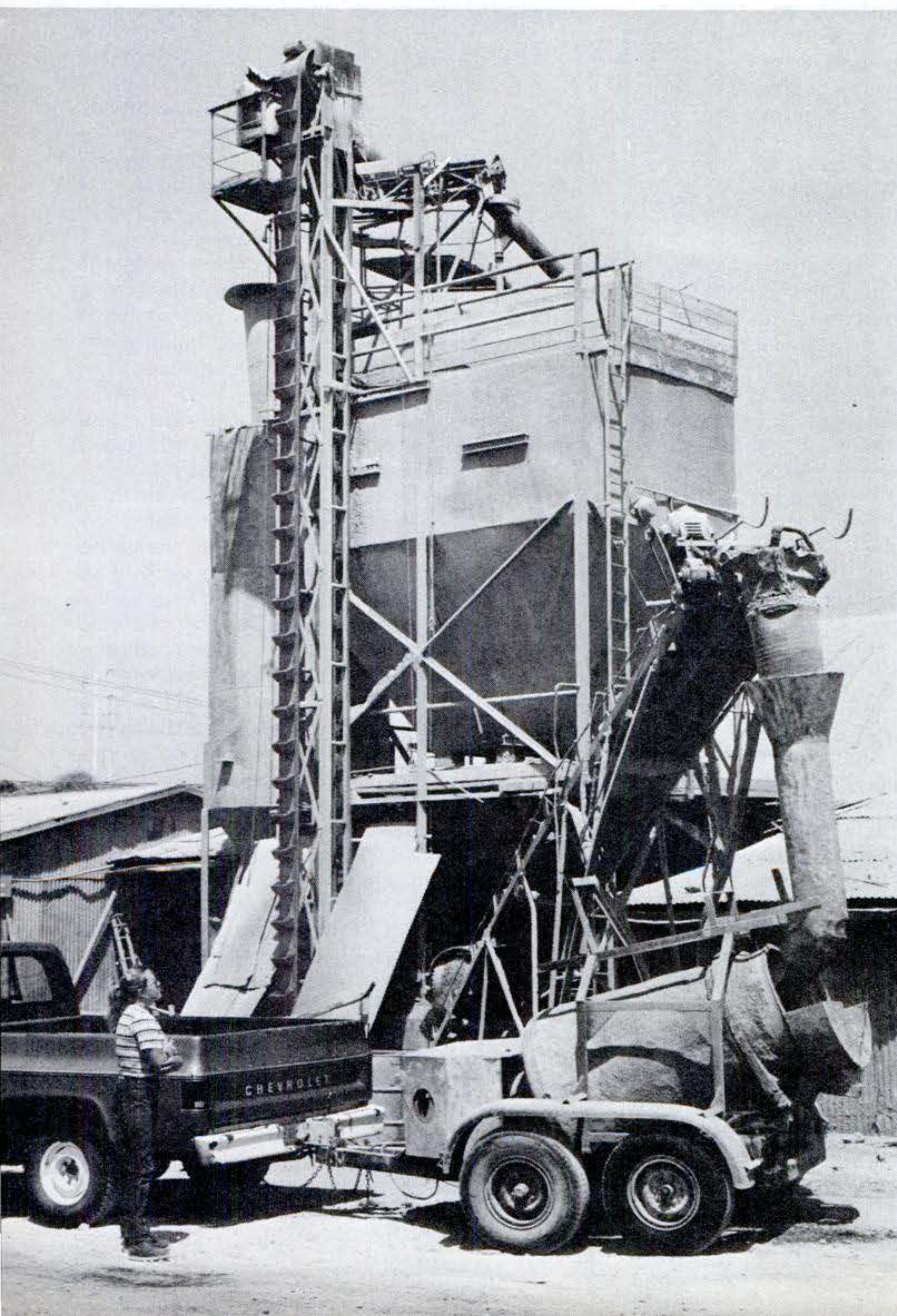
top; upper and lower halves of the "capsule" below. Areas with foam crush structures are shown in color.



The backbone-type frame encloses both the drive train (at left) and fuel tank within

V-shape extensions of the central spine to provide added crash protection.

The hazards of buying **haul-it-yourself concrete**



The material, the mix, and how you take it home make a difference on the job

By **RICHARD DAY**

Lots of DIY outlets are getting into the ready-mix concrete business with haul-it-yourself rental trailers and central concrete plants—and for us homeowners it's super-handly. Just hitch your car or truck to a trailer-load of fresh mix and haul away. Go get it when you wish, and dump where you need it—often in places you'd be crazy to send a monster ready-mix truck. So why *not* go to your friendly local store with the HIY sideline?

One possible reason: Your local dealer may know little about making concrete. Designing, selecting, proportioning, mixing, and transporting concrete are far from simple.

Concrete has two states: plastic and hardened. Plastic concrete needs to be homogeneous and workable. Hardened concrete must be strong and durable. None of these attributes is achieved by accident. Enter the haul-it-yourself concrete industry: lumber dealers proportioning and mixing concrete. Some may know enough to produce a creditable mix, but if you're going to buy HIY concrete, you'd best know a few things yourself.

Hopper hauling

To learn more of what you might run into, I visited a local tool-rental firm recently for a quarter cubic yard of footing concrete. They'd been terrific folks to do business with in the past, but this experience proved to be a classic case of what to avoid.

As I drove into the yard I saw a bin
Continued

at the back, up in the air on legs. Under it was a paddle-type central-mixing plant. Nearby, a row of one-cubic-yard hopper-type dumping trailers was neatly parked. All equipment bore the U-Cart insignia, which was beginning to disappear beneath a concrete skin. With some 700 dealers in the United States and Canada renting 7,000 trailers, U-Cart Concrete Systems, Inc. (Vancouver, Wash.) is by far the largest marketer of HIY concrete equipment and purveyor of concrete-making technology. Each U-Cart dealer is independent. He buys the equipment and is trained by U-Cart in how to use it.

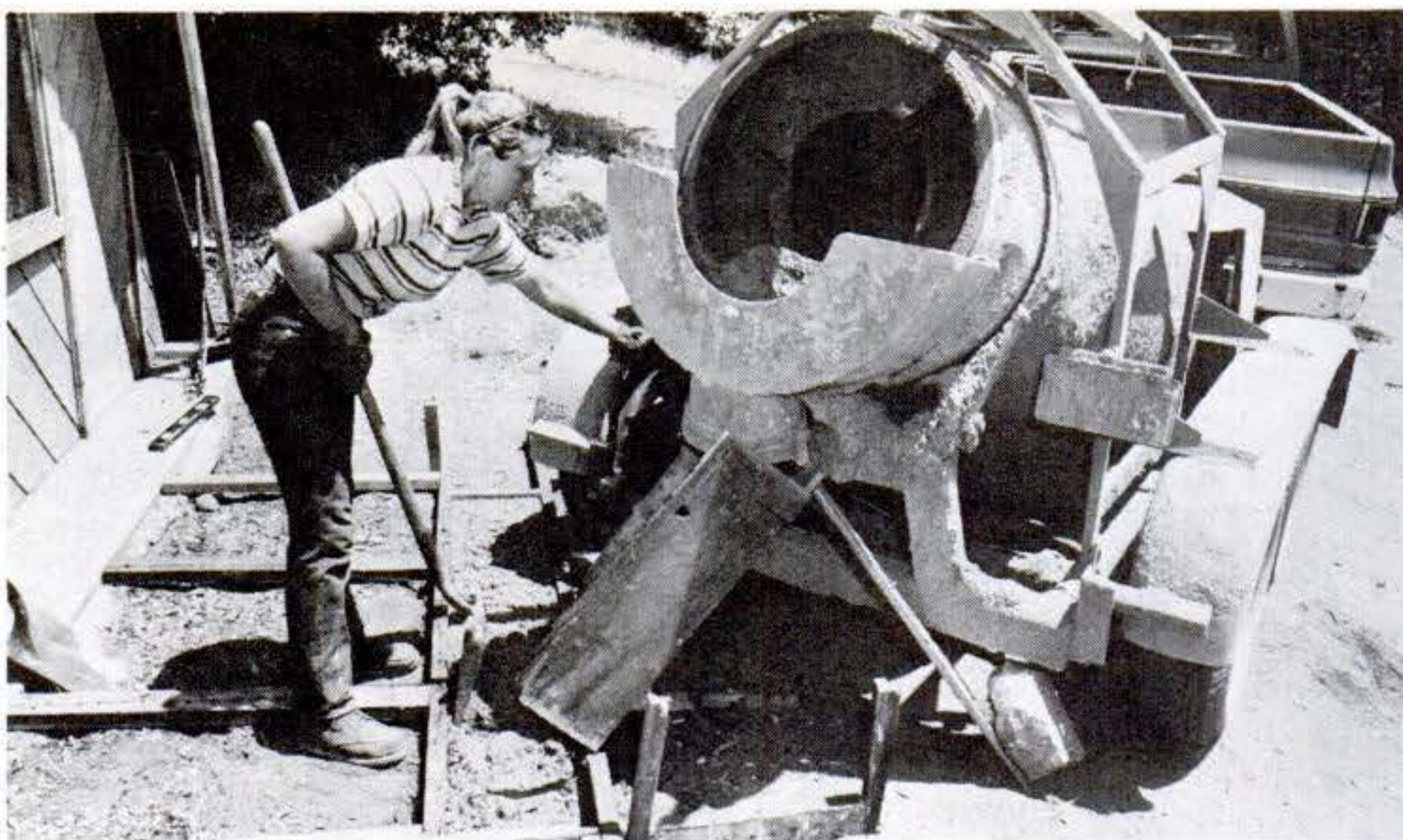
Thereafter, the dealer is left alone to select, proportion, and mix materials and sell HIY concrete under the U-Cart logo. It's a fine idea, but it may fail at the local level. Another problem can be the trailer itself—you'll be given either a hopper trailer or mixing trailer.

Hopper hauling jiggles the mix, so it works successfully only with very stiff concrete. Otherwise water and cement paste rise to the top. The process is called segregation, and it leaves you with unusable layers of ingredients. To avoid this, a concrete with very little slump must be used.

Ralph Spears, manager of the Building Construction Section, Portland Cement Assn. (PCA), told me that two-to-three-inch-slump concrete is probably best for hopper hauling. Slump is a measure of concrete's stiffness or wetness, and six-inch slump is right for most concrete work. This means that a specially compacted cone-shaped pile of it one foot tall will slump into a six-inch-high pile when the forming cone is gently removed. A two-to-three-inch slump is so stiff that the mix stands up in a pile. Power spreading and finishing equipment are needed to handle it.

U-Cart President Rod Brooks agrees with Spears. To help in spreading and finishing, Brooks points to the firm's Fre-Flo air-entraining agent, which dealers are instructed to add to their mixes. With it, he claims, a haul of up to 20 miles can be made. An air-entraining agent creates millions of microscopic air bubbles in concrete. They help to buoy up the pieces of aggregate as well as lubricate the plastic concrete, making it buttery and easy to work with.

But there's a limit. The three-inch slump represents the limit of wetness for successful hopper hauling. Even with an air-entraining agent, a mix that stiff would have to be assisted out of the hopper's one-foot-square dumping door. It would not flow out freely. Often concrete is watered to an eight-



Author's daughter works hydraulic reversing lever to dump concrete from mixing trailer.

inch slump or greater so it will pour into forms and spread easily. That's bad practice. Strength, likewise, is watered down.

So when using hopper-hauled concrete, should you find a dealer who will make a properly stiff mix? No. When you got it home, you'd have to fight it into the forms and coax a finish onto it.

An easier solution, I believe, is to find a dealer who offers trailer-mixed concrete. This mixes as you haul it home. (U-Cart sells a mixer trailer, but few dealers stock one because of the cost.) Throw a lever and the one-cubic-yard mixer drum reverses and dumps its load. Segregation cannot occur. Slump can be an ideal, workable six inches. Dealers who have the costlier mixing trailers advertise them (look in newspapers and the Yellow Pages). A pickup-mounted mixer—you rent the truck and mixer—might be just as good if you can find one.

Rule of sixes

The rest of the HIY success story involves the materials that go into the concrete. Concrete contains three basic ingredients: portland cement, aggregates, and water. There's usually little problem with the materials, but the proportions affect the quality of the concrete. The usual proportions for quality concrete are based on one cubic yard of finished mix. It's a "rule of sixes." The first six is six inches of slump. The second: six sacks of cement—a cubic yard of good concrete should contain six sacks of portland cement to ensure enough paste in the mix to properly bond the aggregate.

However, lots of ready-mix concrete producers sell a five-bag mix: five sacks of cement per cubic yard. It works, especially when larger stones help to fill out the mix. U-Cart instructs its dealers to make a four-

bag mix unless additional strength is needed. Brooks says this provides a compressive strength of about 2,400 psi at 28 days.

While 2,400-psi concrete might be fine for projects not subject to freezing and thawing, if you want quality for moderate and severe exposures, says PCA, you'll shoot for 4,000 psi at 28 days. That's good concrete!

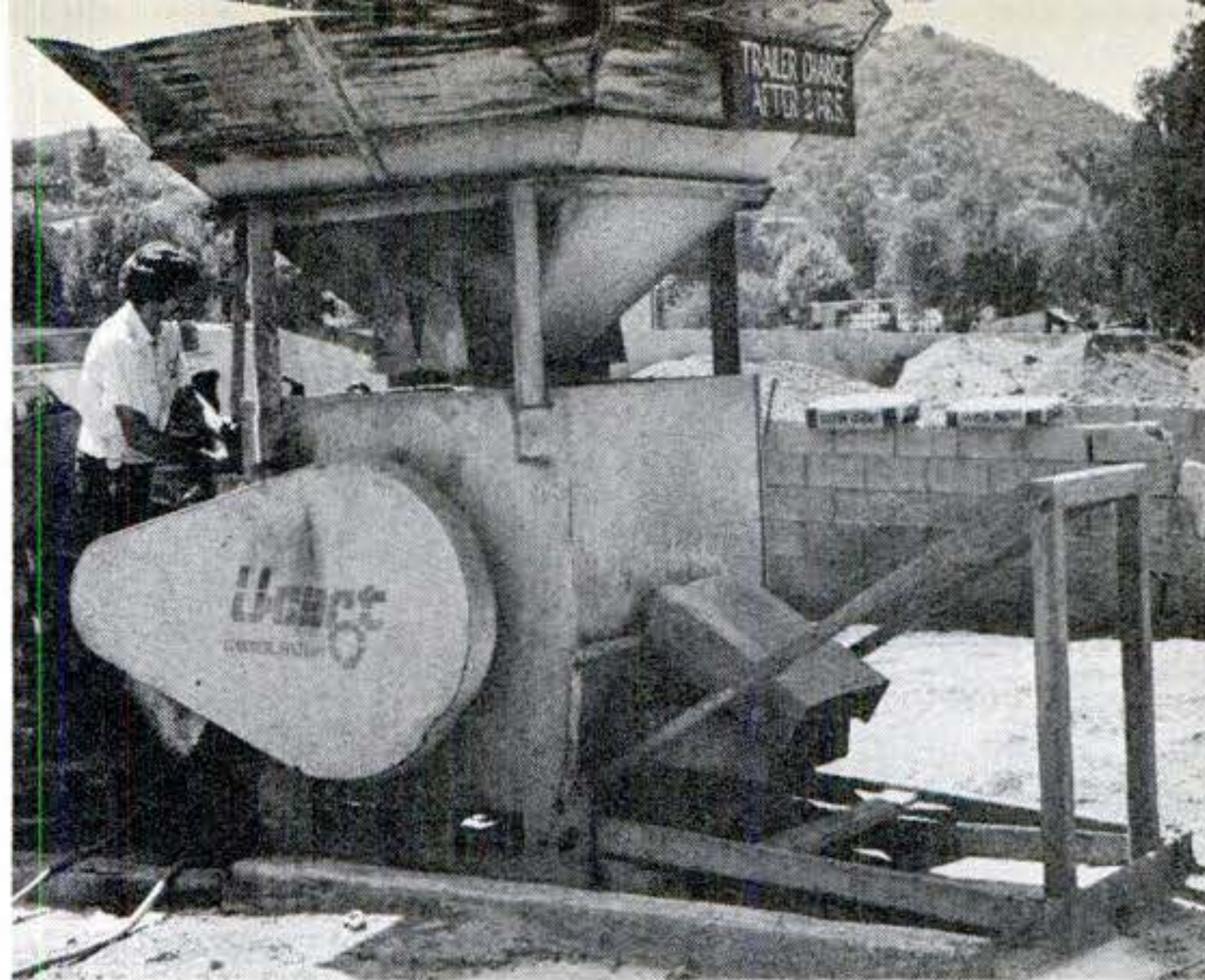
Where larger aggregates cannot be used in the mix—as in most do-it-yourself concrete—a six-bag mix is necessary. You cannot test compressive strength, but your dealer may have test data on the mixes. Weak concrete tends to crack, craze, scale, dust, spall, and wear rapidly, none of which will make you proud of your job.

The third six involves the quantity of water used. The less water, the stronger the mix, and vice versa. For complete hydration, one sack of cement needs only about three gallons of water. Since such a dry mix would not slump even three inches, another three gallons of water per sack is added for a total of six. The added water helps you place and finish the plastic mix. If more water is used, the concrete becomes weak from pores left after the excess water leaves. Six gallons of water per sack of cement can make 4,000-psi concrete at a six-inch slump—you get strength and durability plus workability.

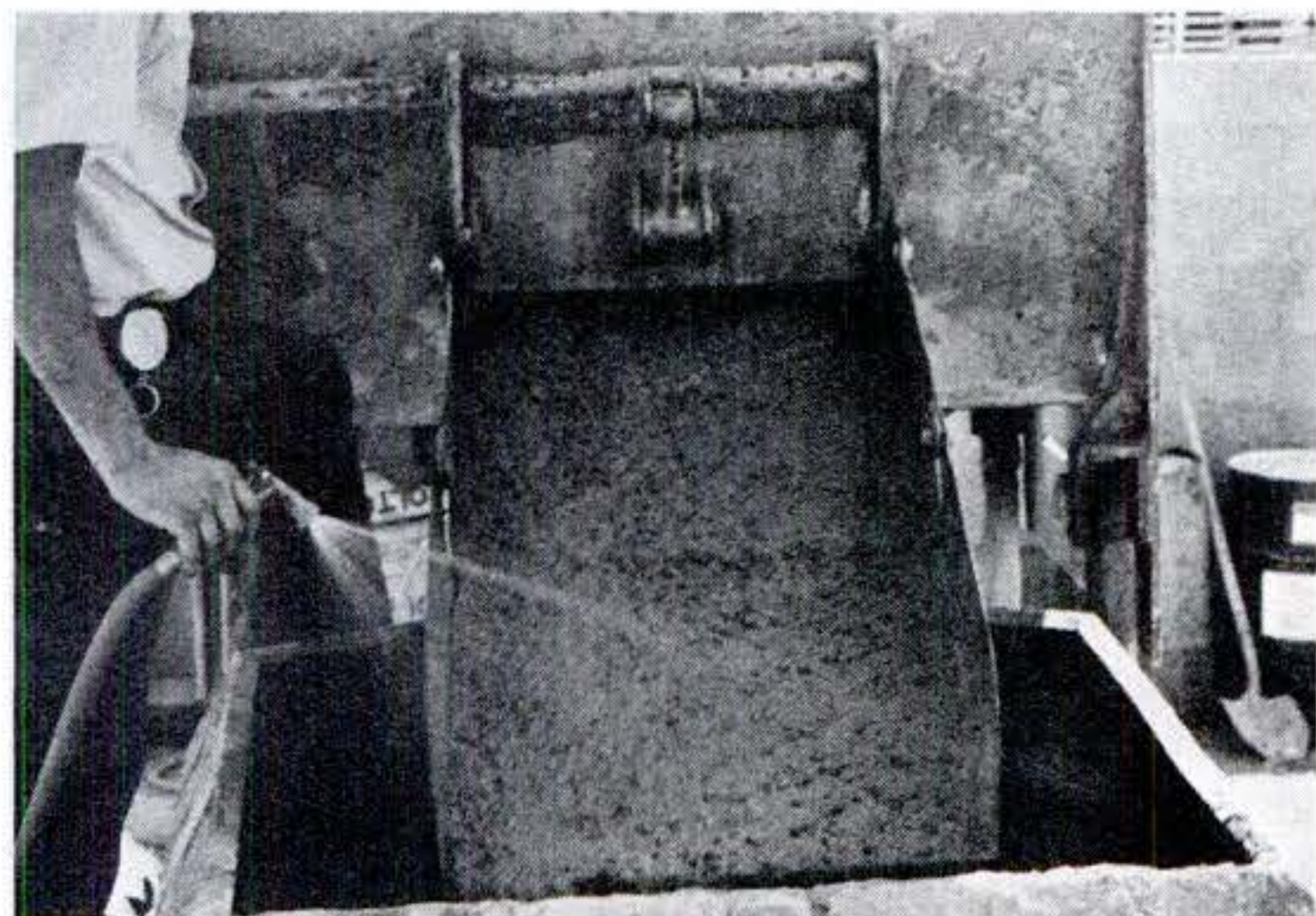
But this doesn't mean a dealer can just run 36 gallons of water into a cubic yard of six-sack concrete ($6 \times 6 = 36$). The water already in the sand must be taken into account. For example, with average-wet sand, only $5\frac{1}{2}$ gallons of water per sack of cement is added to the mix. U-Cart provides dealers with wetness tables. The amount of water added depends upon the aggregate condition to get the desired three-inch maximum slump for hopper hauling.



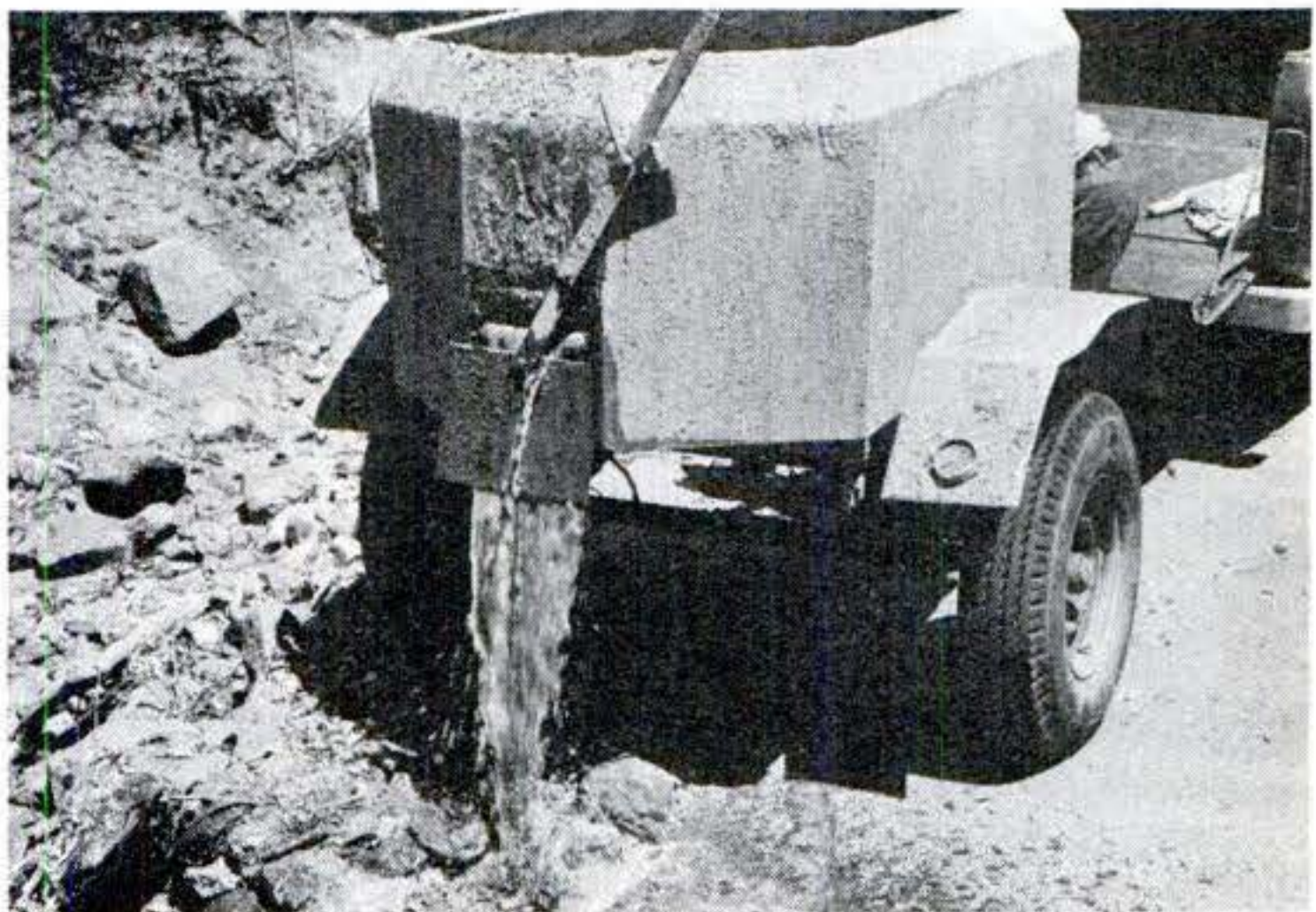
Aggregate size is important for good concrete. Both the gravel and sand should be hard, clean, and uniformly graded.



Mixer for hopper trailers is volume-batched by front-end loader. Ingredients enter at top bin, drop and mix at bottom.



Water should not be sprayed into mix. Mixture becomes soupy and segregation begins. Water should be metered in.



Result of a sloppy mix and hopper hauling: gallons of cement slurry on top of mix; settled, unusable material at bottom.

But too few HIY dealers measure the water they add. They guess. If you want quality, insist that water be measured. U-Card supplies dealers with meters for this purpose.

Aggregates

When you specify an aggregate size, you are merely giving the size of the largest stones used in the mix. An ideal aggregate, however, also includes a number of smaller stones in uniform gradations down to the smallest bits of sand. The various sizes help fill voids in the mix, leaving the cement to function as a glue, not a filler.

The proportion of sand and stones is best based on a trial mix. Your dealer should make one, using the same kind of sand and stones he will use in your mix. A mix with too much sand may be easy to finish but tends to shrink greatly, crack, and craze. A mix with too much gravel is hard to finish; stones obstruct the float and trowel. Either way, cement is used up as filler. Strength and durability suffer.

Air entrainment

If you live in a freeze-thaw climate, you should not build outdoor concrete

without air entrainment. Those air bubbles in the mix act as safety valves to protect hardened concrete against damage by internal freeze-thaw pressures.

Either air-entraining portland cement (types 1A or 2A, the A standing for air entraining) must be used or an air-entraining agent must be added to the mix. A common one is the vinsol resin used by ready-mix producers. U-Card's Fre-Flo, already mentioned, is another. They aren't costly. Ask how much to put in your HIY mix for approximately six percent of entrained air. (It's one pint per cubic yard when using Fre-Flo.)

The air bubbles also keep excessive water from bleeding to the surface, letting you begin finishing operations that much sooner. For this reason—as well as for the greater portability discussed earlier—you may wish to use air-entrained concrete even where it won't see icy conditions.

Two concrete tales

"I'd like a stiff mix," I told the manager of my tool-rental yard. "We have a long way to go with it." I reiterated that the concrete was for a footing. (A

footing's important; a wall stands on a footing.) He backed the hopper trailer to the central mixing plant for loading while a batch attendant took care of making the mix.

"How do you know the proportions of cement, sand, and stones are right?" I asked. The manager told me that he did it by scoops with a front-end loader: a scoop of stones and a scoop of sand plus one bag of portland cement for each one-quarter cubic yard, ending up with a four-bag mix. But batching aggregates by volume is not the best way, as sand volume varies with wetness. And batching in a loader bucket is worse. The operator can't see whether the bucket is full, part full, or what. He scoops, hopes, and dumps. If he's lucky, he gets a full bucket.

My batching attendant did not use a water meter. He added water to the mix with a hose and spray nozzle, unmeasured. He put plenty in, too, even though I'd asked for a stiff mix. I asked how he knew how much water to put in.

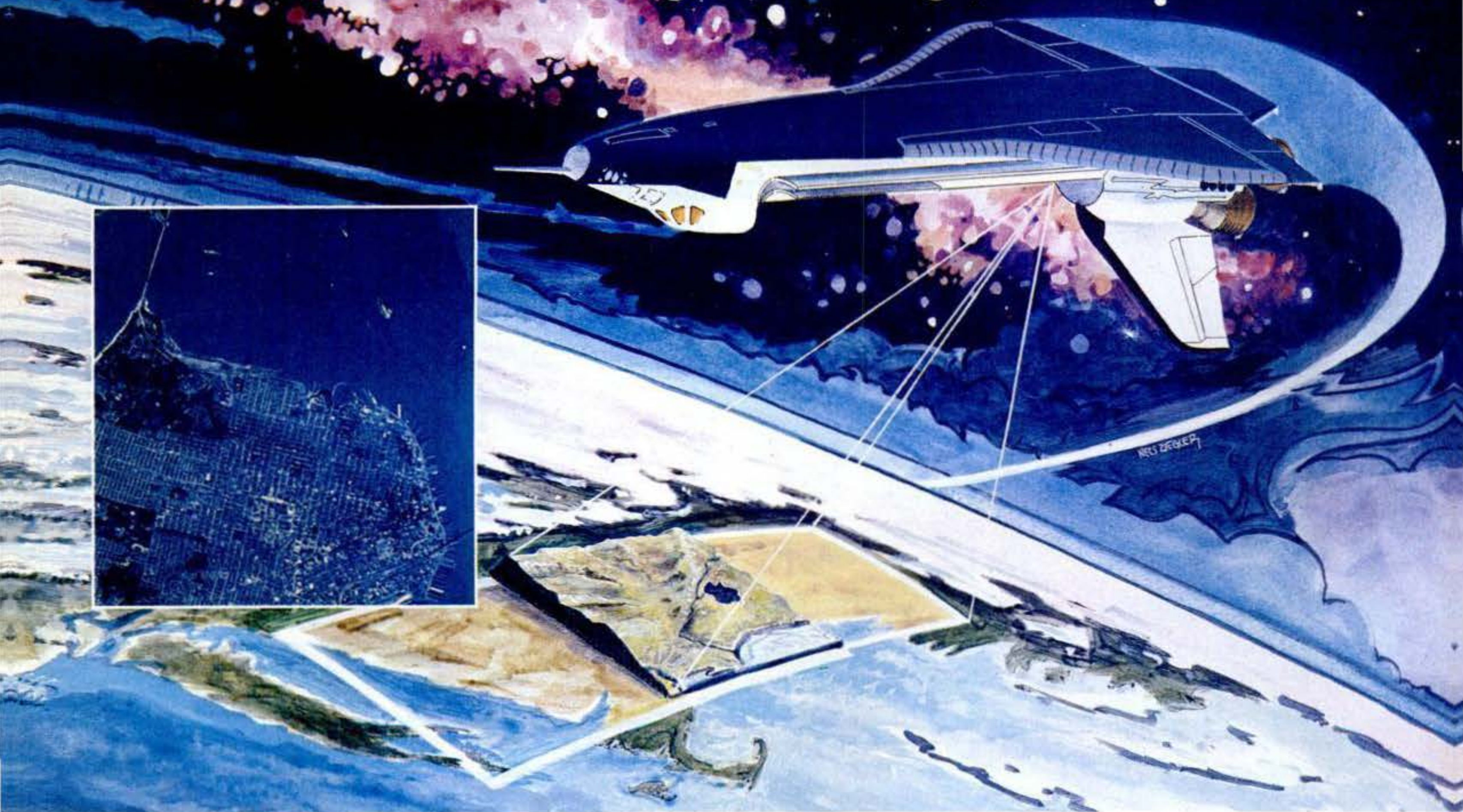
"By how it looks," came the reply.

Someone with lots of experience in using concrete from a mixer can prob-

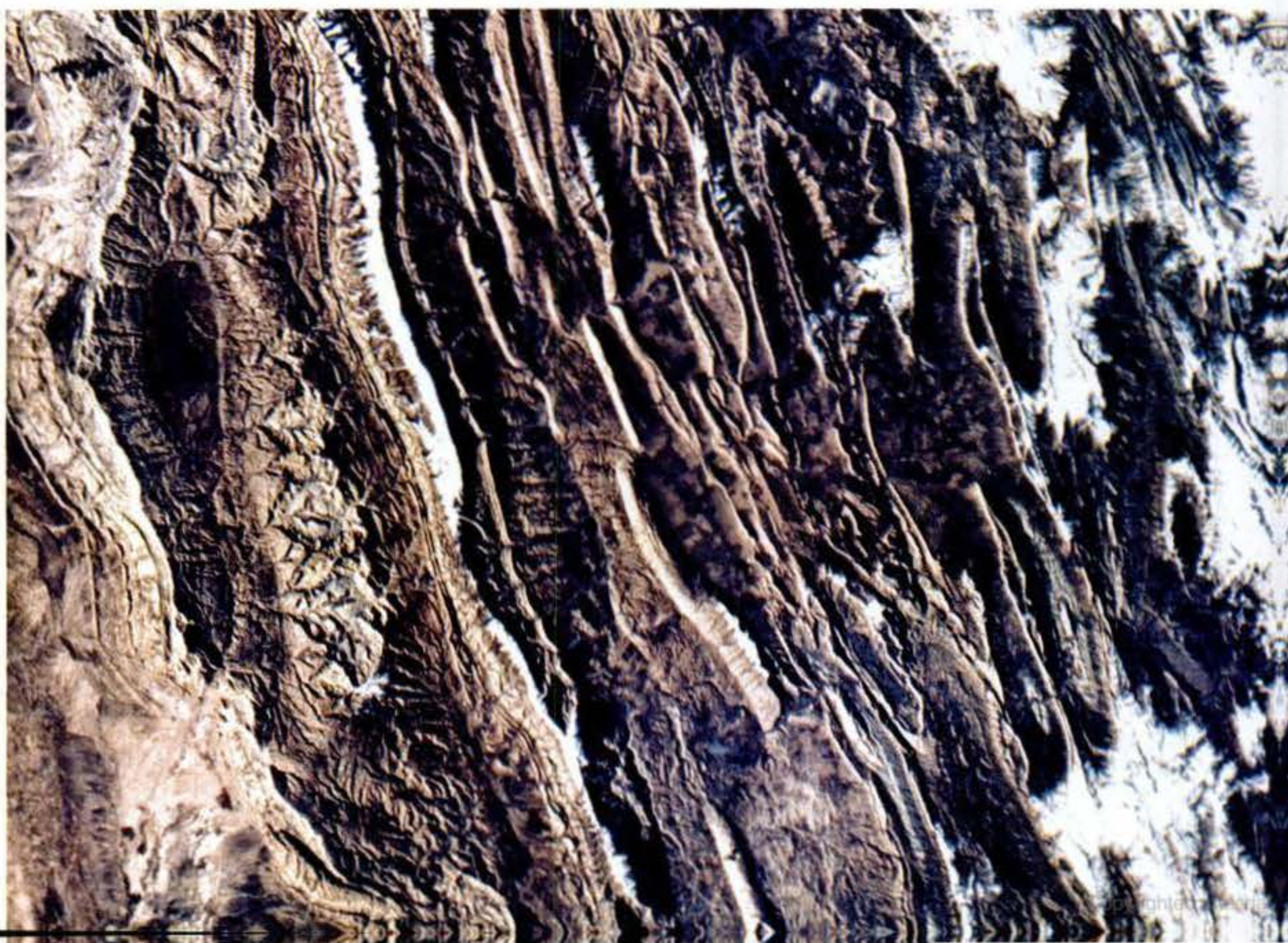
[Continued on page 106]

New eye in space

Shuttle camera will get the big picture



Close-ups from 120 miles high: One photo frame from ITEK's Large Format Camera, to be flown on the Space Shuttle, will cover an area of about 20,000 square miles. But its clarity and geometric fidelity will be superior to earlier space cameras, such as Skylab's Earth-Terrain Camera, which snapped these photos of downtown San Francisco (inset) and Iran's Zagros Mountains (right). It will also provide topographic accuracy (when overlapping pairs of images are viewed in stereo to exaggerate the vertical dimension) five times better than the Apollo cameras that mapped the surface of the moon.



Viewed from above, our busy planet takes on new perspective

By DAN RUBY

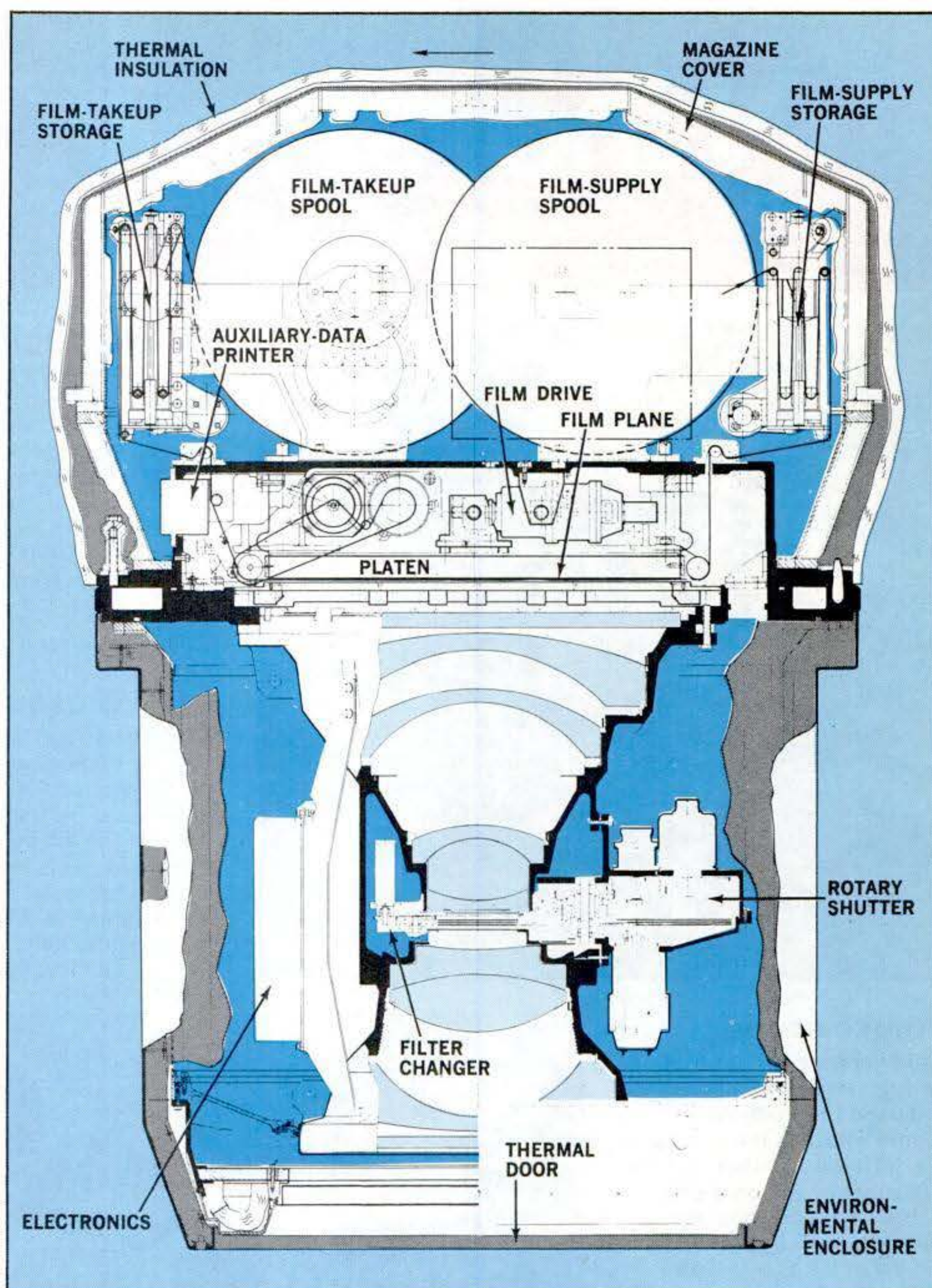
Imagine a camera that takes pictures covering an area the size of Massachusetts with high enough resolution to differentiate between two adjacent buildings in Boston. Such a camera will fly on an upcoming Space Shuttle mission—and map makers, geologists, land-use planners, and others can hardly wait to see the pictures.

The Large Format Camera, developed by ITEK Corp. (which also built cameras for the Apollo, Skylab, and Mars Viking spacecraft), is the first space camera to combine exceptional resolution (as good as 30 feet from an altitude of 120 miles) and wide field of view (74 degrees in the direction of motion), ITEK says. It is essentially an oversize aerial-survey camera, but its images will cover about 20 times as much area as those of a conventional camera flown at 45,000 feet. And when overlapping images are viewed through a stereoscope they will provide contour information, under optimum conditions, accurate to 30 feet.

These capabilities have spurred interest from a lot of potential users. At the front of the line are the map makers, who point out that only about 20 percent of the Earth's surface is adequately charted. "Not only does man build new highways, enlarge cities, change the paths of rivers, and dismantle mountains, but the Earth also reshapes itself," said NASA's Bernard Mollberg. "Even since the era of space photography began [with a hand-held Hasselblad pointed out the window of a Mercury capsule], we have seen shifts in the land, movement of deserts, and the rise and fall of islands."

Another important application is in photogeology. Trained interpreters will study the stereo images to identify drainage patterns, folds, domes, and other indicators of likely petroleum and mineral deposits.

Mounted on a special pallet in the Shuttle's cargo bay, the camera will follow a preprogrammed photo sequence or receive orders from the ground. One load of film will yield about 2,400 nine-by-18-inch images. It will take five Shuttle flights for the camera to cover the entire global area the spacecraft will fly over in its early missions—most of the southern and up to 57 degrees of the northern hemisphere, including all of the continental U.S. Later Shuttle missions will go into polar orbit and allow coverage of the entire planet. Eventually, the



Large Format Camera is named for its film size, but it's big in other ways, too: 4½ ft. tall and 945 lbs. (film alone is 70 lbs.).

camera might be deployed on the planned Multi-Mission Spacecraft, which would be left in orbit on one Shuttle mission and retrieved months later on another.

The camera's 305-mm f/6 lens uses eight glass elements (see drawing) plus several filters to accommodate color, black-and-white, and color infrared film spliced together on one roll. The lens cone sits in a temperature-controlled enclosure pumped full of nitrogen to 1.5 psi, providing a negative pressure between the lens and the camera back. This holds the film against the platen in the zero-gravity environment and prevents static electricity and film brittleness. The rotating-disc shutter operates at speeds of 0.004 to 0.032 seconds, controlled by a brightness sensor that nullifies reflec-

Camera is mounted on a special bridge to withstand repeated launches. Thermal door opens only during exposures.

tions from clouds and snow. The film advances during exposures to compensate for the spacecraft's 17,000-mph ground speed.

NASA has not yet committed itself to a firm launch date for the ITEK camera. "Right now, we are totally involved in getting the Shuttle's test flights behind us," a spokesman said. "Payload schedules have not been determined." (PS will report on other planned payloads in a future issue.)

While they wait for the camera to get off the ground, cartographers and geologists are betting that it will confirm a statement President Johnson made in 1967: "If nothing else comes out of the space program, the knowledge we'll gain from space photography will be worth 10 times the cost of the whole program." ES

What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



Smoke scope

Fire fighters can peer through smoke to pinpoint exits and obstructions in rooms with this thermal camera. Infrared radiation creates a thermal image on a one-inch screen, which is magnified by a lens. English Electric Valve Co. Ltd., Essex CM1 2QU, England.

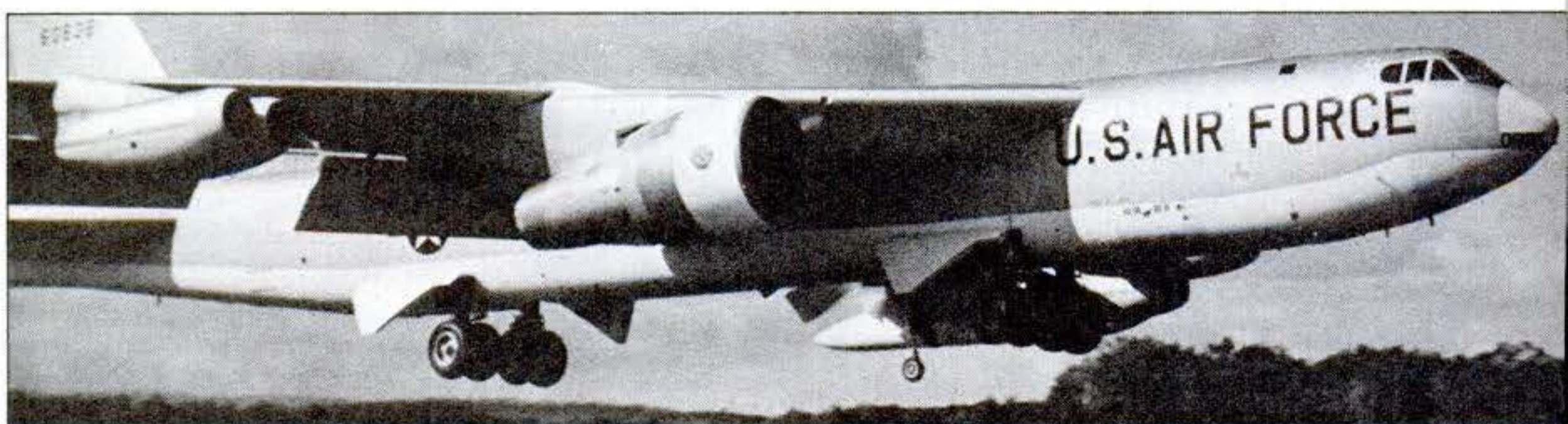
See-through glove

Outfielders shouldn't be blinded by the sun if they're using Mizuno's new baseball glove. A polarized, see-through pocket makes tracking high flies easier. Pro models (up to \$150) could be ready soon, with additional models in a year or two, says the Japanese maker.



Mosquito net

Backpackers can leave heavy tents at home and still avoid mosquitoes at night with Mosquito-Sleeper, says the maker. The six-ounce sleeping-bag net is set up like a tent and the waist drawstring is tightened. \$14.50. Blue Nose Equipment, Box 1213, Quincy, Calif. 95971.



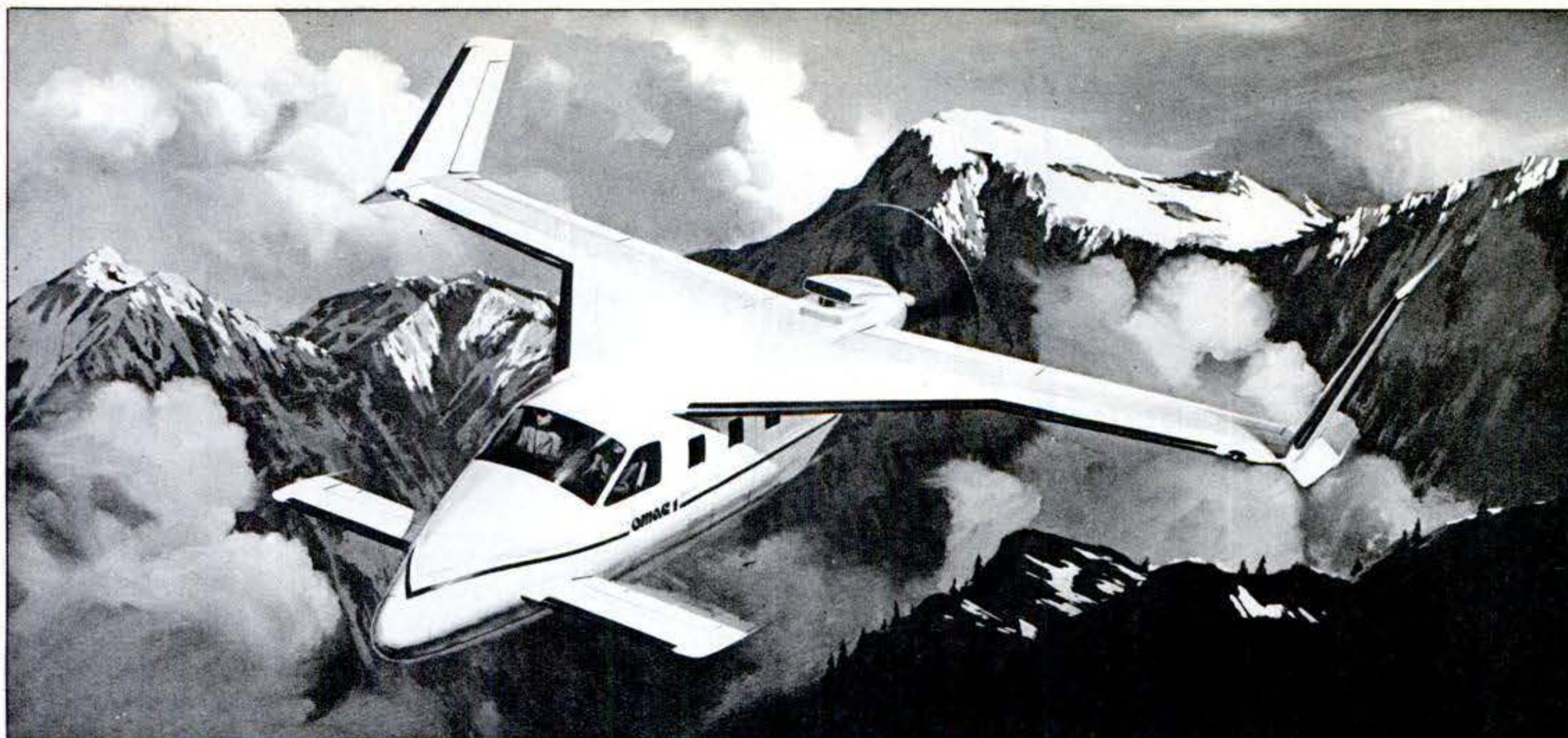
Fuel-saving engine

A single fuel-efficient JT9-7R4 turbofan engine replaces two right-wing turbojets on this B-52. Pratt & Whitney Aircraft leased the bomber for certification tests of its new power plant (an updated JT9D), selected by 14 airlines for their wide-body passenger aircraft.



Safety truck

Add-on features boost safety on a Leyland Roadtrain tractor-tanker. The research safety vehicle, a British government/industry effort, has anti-skid and fireproof fuel systems, tire-pressure monitors, rear-view mirror with wipers, and a double-skin, six-compartment tanker.



Wide-body OMAC

A wide-body, six-passenger business aircraft, OMAC 1, has a pusher-type jet prop, up-front canard wing, and winglet rudders at the wing tips. The low-noise, 700-hp engine provides a 300-mph top speed and 3,000-mile range. Omac, Inc. (Reno, Nev.) is building it.

Guided tractor

Now, for long rows of crops and precision weed cultivation, there's TAG (Tractor Automatic Guidance). Twin discs steer tractors precisely by following a V-shaped groove in the soil made during a previous pass. Geosource, Inc., Modesto, Calif. 95355.



280-ZX turbo

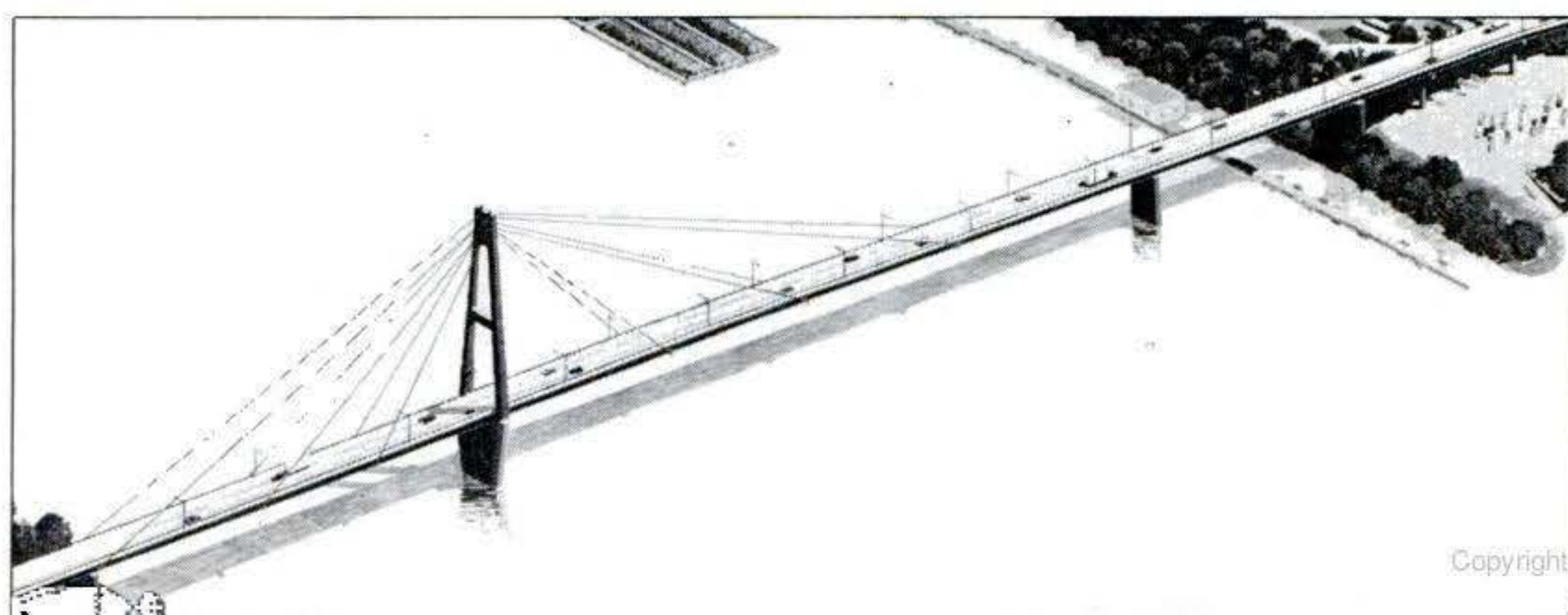
Floor the accelerator of Datsun's 280-ZX turbo and you've got 180 hp available—35 hp more than the conventional ZX. For the added zip, combined EPA mileage drops from 22 to 21 mpg, says the maker. The ZX turbo includes a heavier drive train and special handling gear.

Inflatable wader

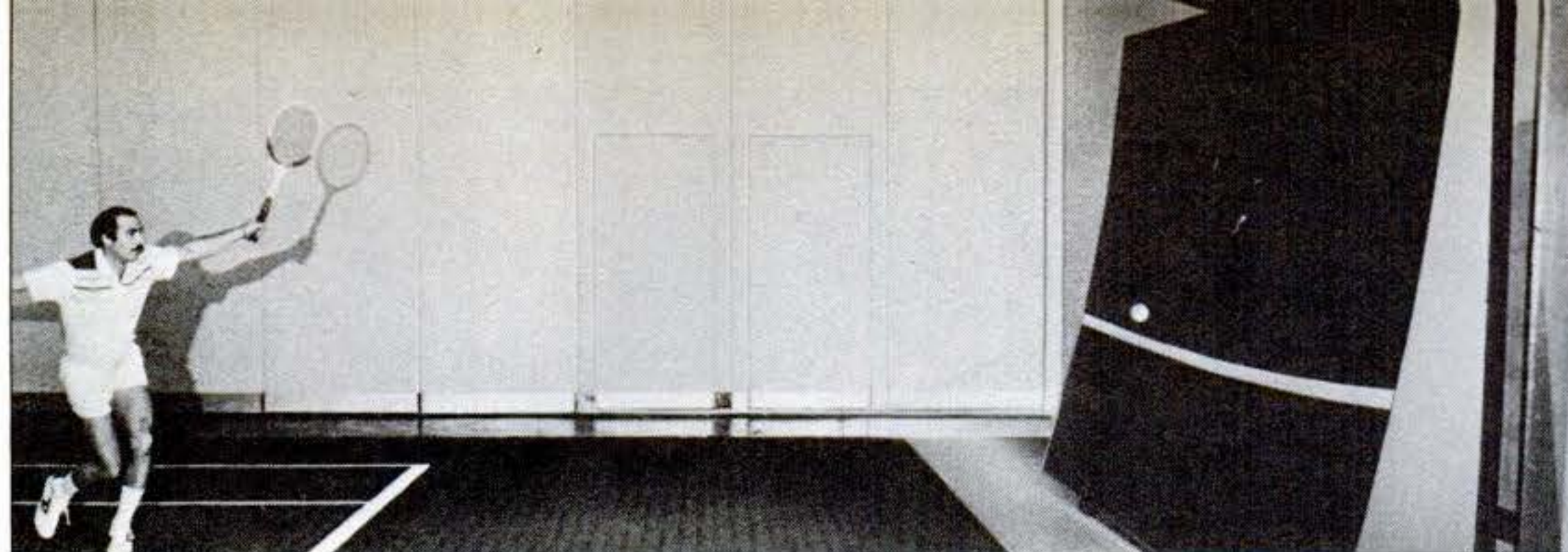
An air chamber in its Featherweight wader minimizes water seeping in if you slip, says Hampshire Mfg. Corp. (Box 428, Nashua, N.H. 03061). The chamber, less than three inches in diameter, forms a seal around your chest and helps keep you afloat.

Asymmetric span

An asymmetrical, cable-stayed bridge—first of its type in this country—will link Huntington, W.Va., and Proctorville, Ohio. The A-shaped tower straddles the bridge's box girder nearest the Ohio side of the 900-ft. main span. Total span length: 1,993 ft.



What's New

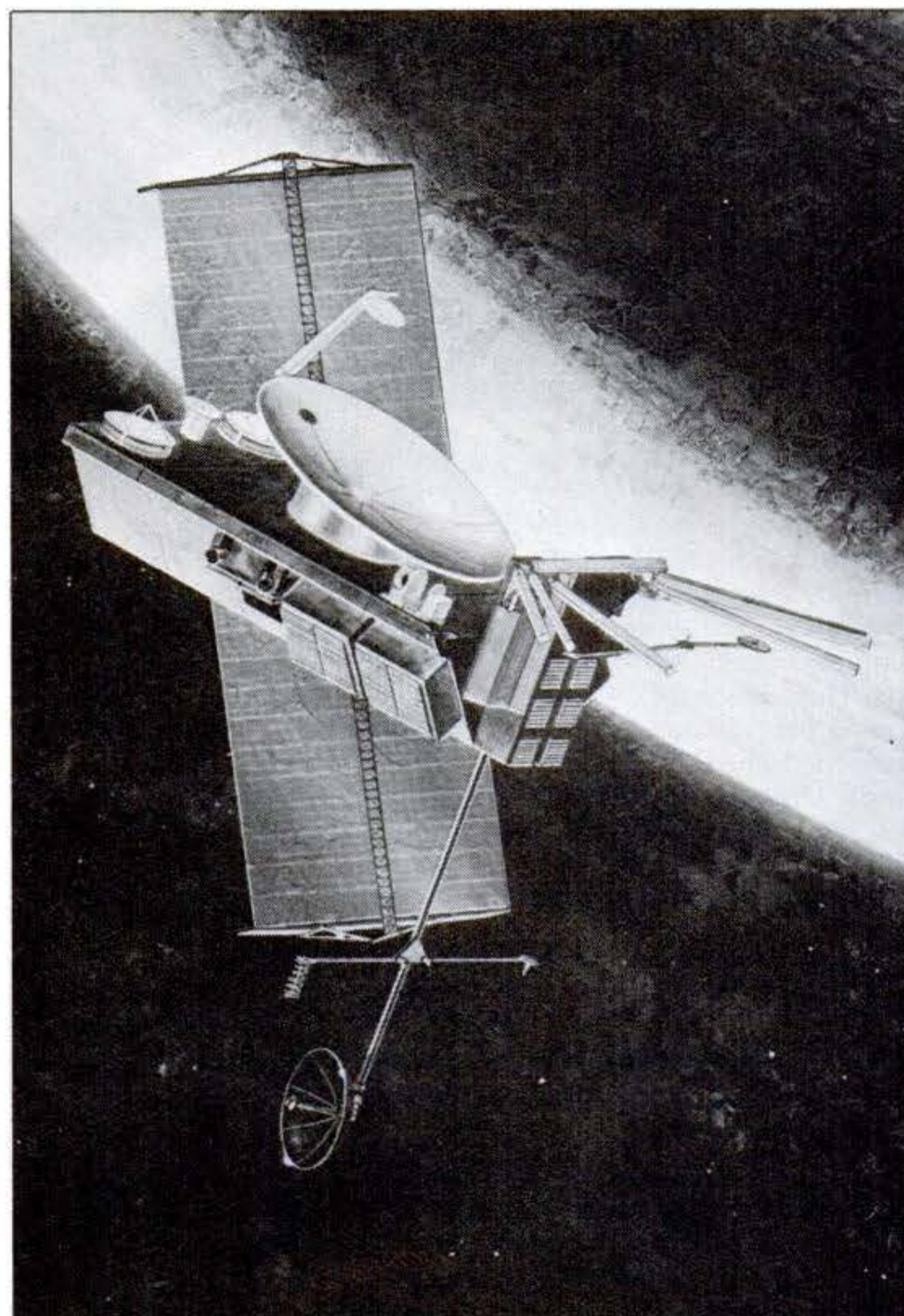


Better backboard

Bad shot? The polyurethane backboard returns the ball anyway, keeping the rally going. The sloping board lofts balls high so they land with one bounce, 39 feet away—just where the base line is. Jimmy Connor's Rally Enterprises of Sterling, Va., makes the board.

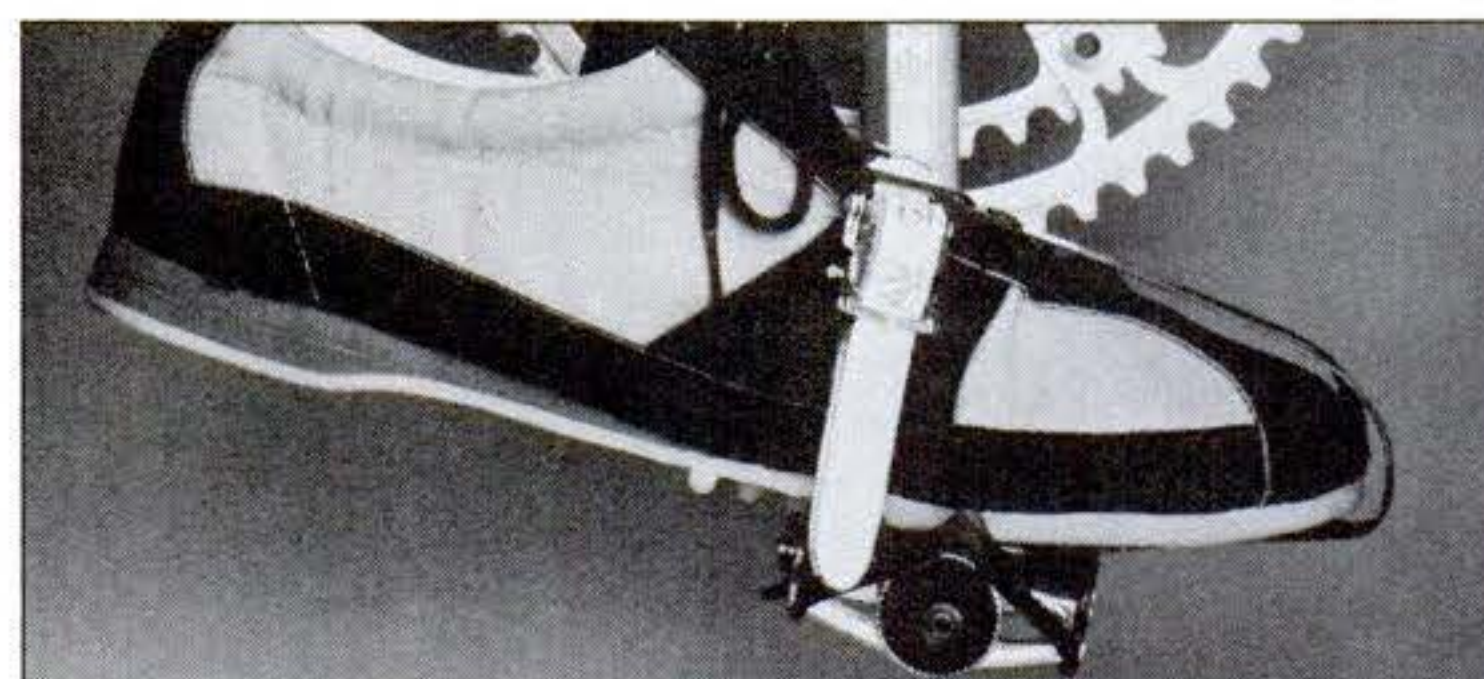
Wave watcher

Focusing its microwave eyes on the oceans of the world, this sea-state monitor will keep 24-hour watch on ocean weather conditions. It will measure wave heights, water temperatures, and surface wind speeds daily. The watch bird will also note changes in ice buildup and ocean topography, and will check for pollution damage. The Lockheed design shown is one of four different proposals for the new National Oceanic Satellite System. It is scheduled to begin operating in the mid-1980's, when the Space Shuttle will launch two of the ocean-monitoring satellites.



Efficient lift

An ordinary-looking elevator panel operates an advanced "workhorse" elevator for mid-rise buildings. Its solid-state, direct-drive AC unit monitors speed signals and instantly adjusts elevator motion. This gives a smoother, faster ride, says Otis, and also cuts energy costs.



Chopper radar

The black box mounted under the Sikorsky helicopter shields a radar antenna. The Army's new aerial-surveillance helicopter also has an electronic-data terminal inside the cabin. The system can monitor enemy troop movements and relay data directly to battlefields.

Pedal gripper

Instead of cleats, the Model II Cycle-Touring Shoe has angled channels that clamp onto the pedal. The shoe's raised, cushioned heel and contoured innersole make it equally efficient as a walking shoe, says maker Avocet (Box 7615, Menlo Park, Calif. 94025). \$33.

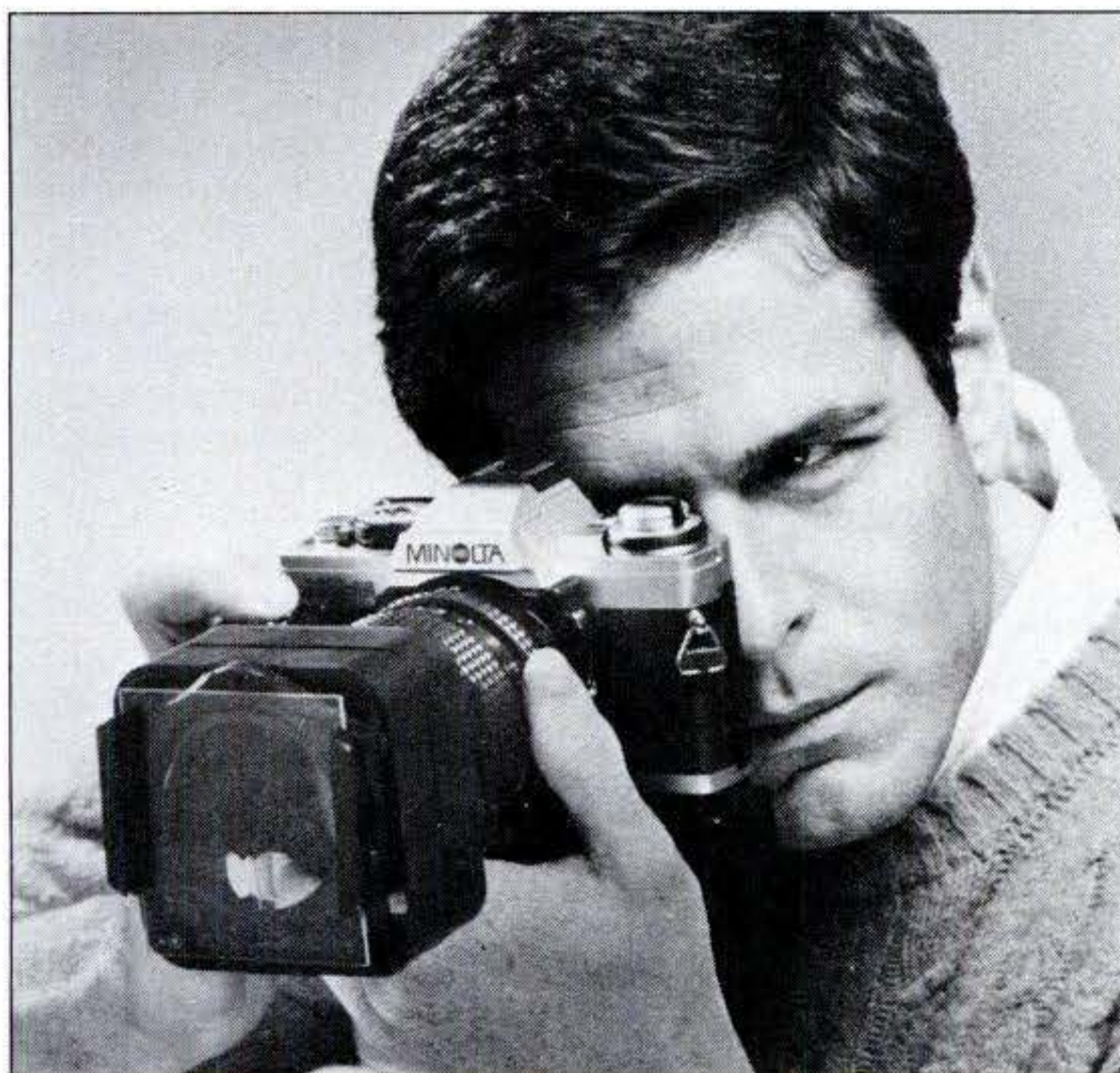
What's New IN PHOTOGRAPHY

BY E. H. ORTNER



Lightweight cat

You get a lot of millimeters at a reasonable price with the new Celestron f/5.6 500-mm catadioptric telephoto lens. It lists for \$295, weighs 2¼ lbs., is 7½ in. long, and focuses to four feet. Maker: Celestron International, 2835 Columbia St., Torrance, Calif. 90503.



Filter system

An expanded Cokin filter system now includes a P series, which, through adapter rings, can be used on lens diameters from 48 to 82 mm, and even on Hasselblad/Zeiss lenses. And a new holder (left) can hold up to three filters at a time. Cokin accessories are distributed by the Minolta Corp.

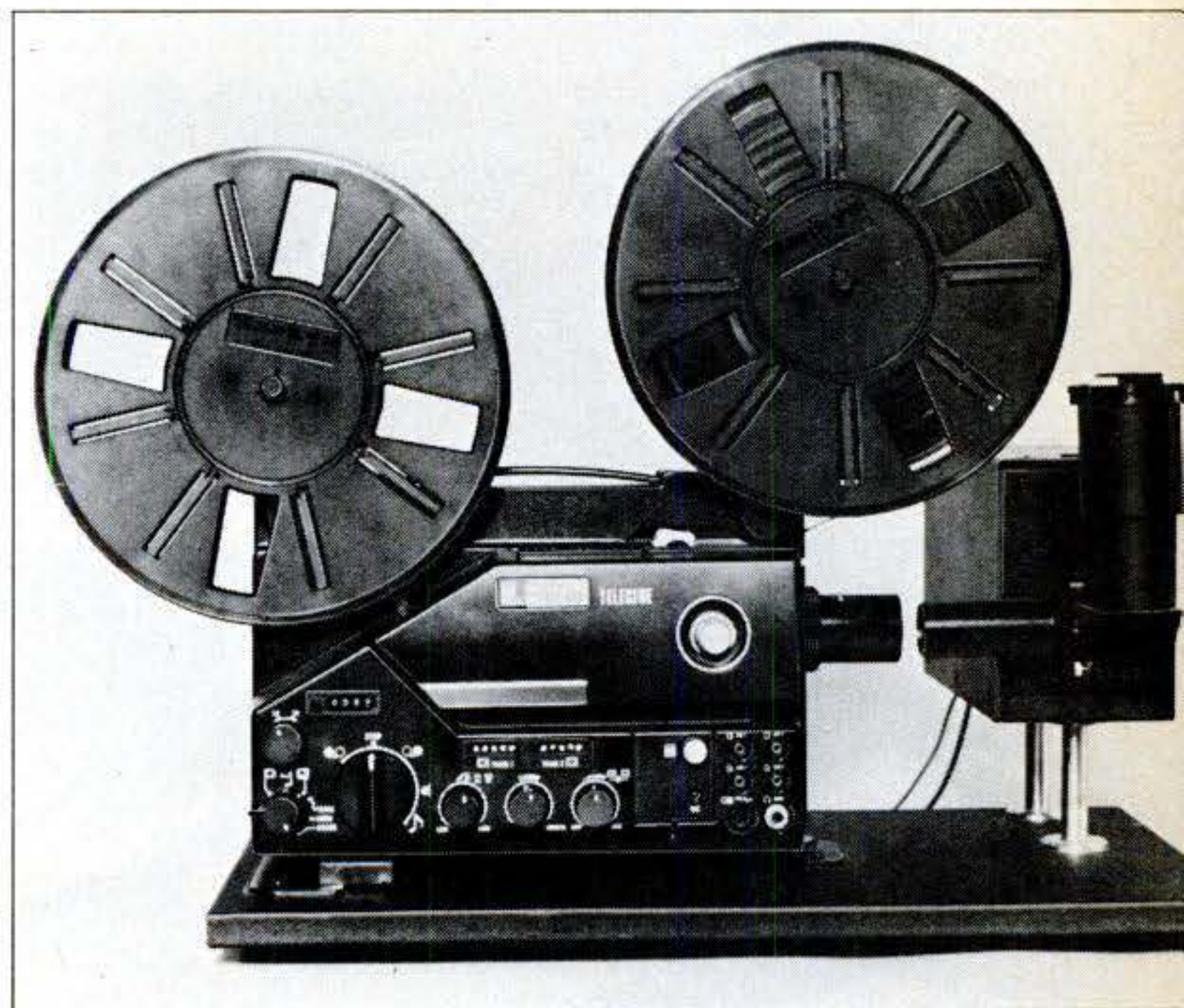
One-dip color

One solution—an activator—is all you need to process Ektaflex color prints. The new Kodak system uses a special print maker (\$134.50) that laminates color film, which you expose in your enlarger, onto a special paper. The dyes migrate to the paper. Time: six to 15 minutes. Cost of 8×10: \$2–\$2.50.



Shifty lens

Plaubel's no longer a German make. Instead, the Plaubel Makina is made in Japan, as is the new Plaubel Proshift (left), a 2¼-by-3¼-in. (image size) camera with a shifting 47-mm f/5.6 Schneider Super Angulon lens. You can move it up or down or to either side to straighten (or induce) distortion. About \$1,500.



Turn-on flash

Promises, promises, but now it's for real: a flash that operates the built-in electronics of most major SLR's—Canon, Minolta, Nikon, Pentax, and most Olympuses. The Vivitar 3500 turns on the viewfinder ready lights and sets the shutter speed by using separate adapters. List price: \$140.

Transfer system

Project your super 8 movies on a regular screen, tape them on your VCR, or view them on your TV set—the Sankyo Stereo 800 Telecine projector lets you do all of those. It synchronizes the film-speed transitions to avoid flickering or striped patterns. Price: under \$3,000, says the maker.



What's New

IN TOOLS

BY PAUL BOLON



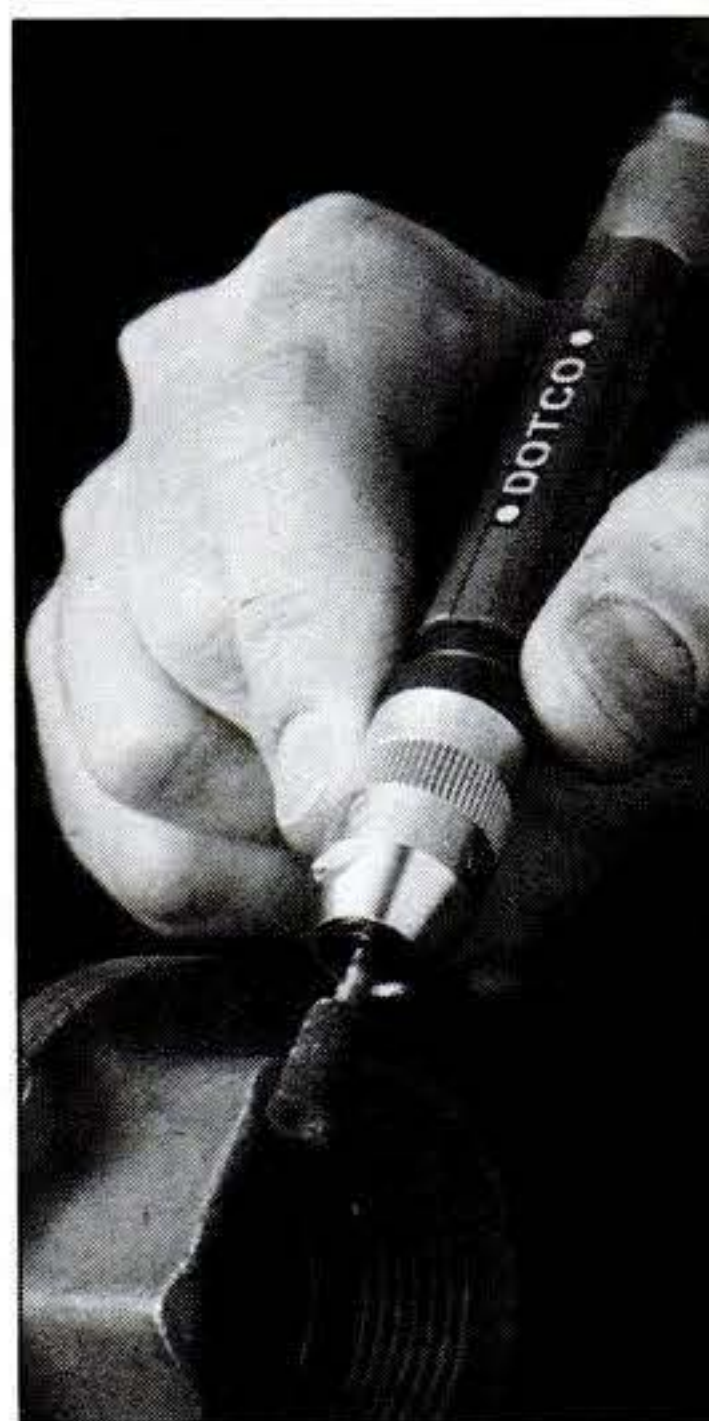
Sanding disc

Need to change sanding grits before your self-adhering paper is worn out? You can with this disc's Velcro-type backing, which allows repeated reuse. The German-made, 115-mm "long-life" discs come in three grits. Proma GmbH, Postfach 6380, Gartenstrasse 54, 4400 Munster, Germany.



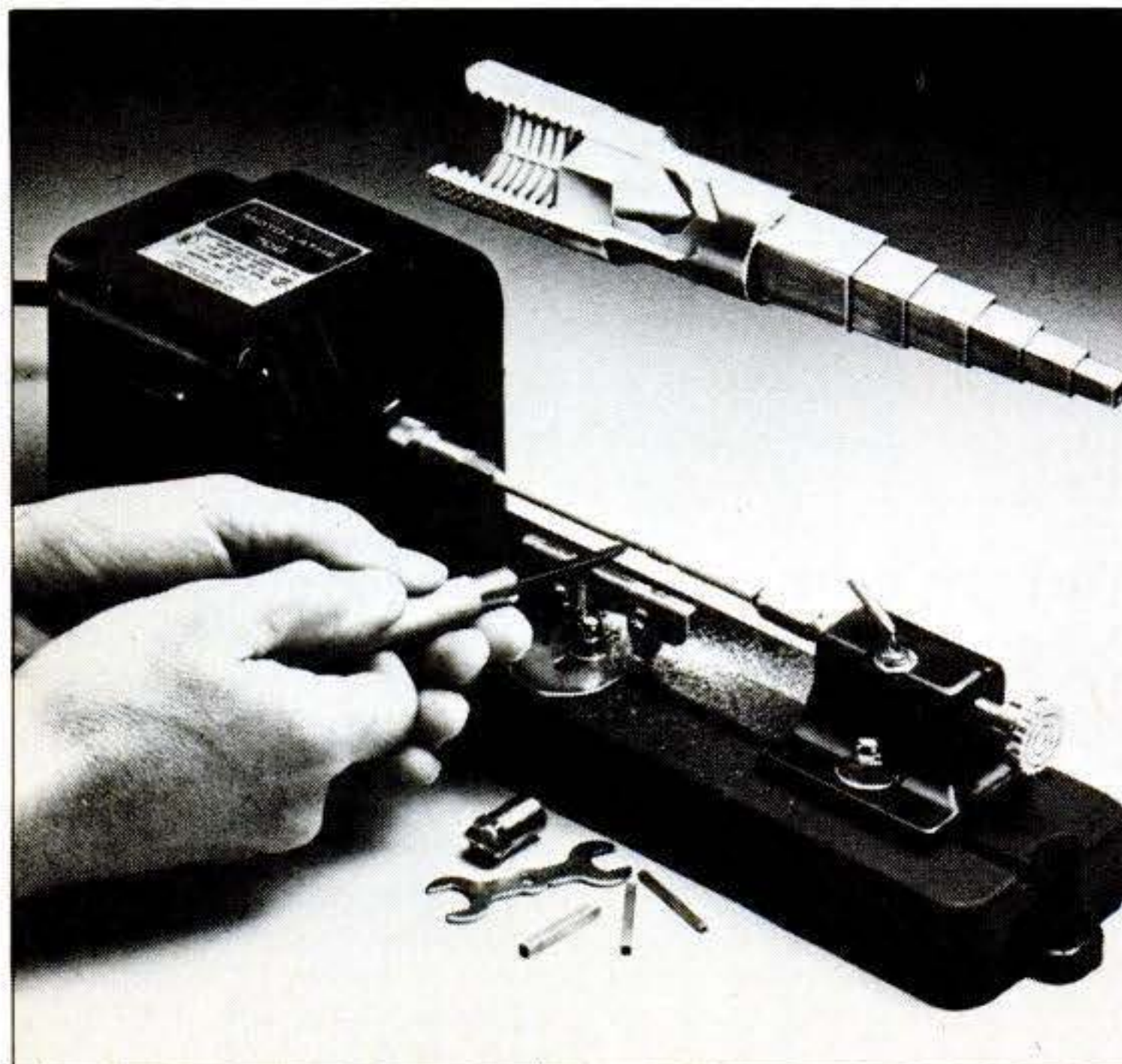
Pencil grinder

Precise engraving, deburring, and welding cleanup are possible with this compact grinder from Cooper Air Tools (1333 Fulton St., Grand Haven, Mich. 49417). The 4.5-oz. air-driven tool has finger-tip control over its 60,000-rpm top speed. Bits are changed without a collet wrench.



Tiny chuck

Six removable tubes ($\frac{1}{16}$ – $\frac{1}{4}$ inch) are telescoped into Dremel's new lathe chuck. They enable you to fashion small-diameter round or square stock for model parts or other miniature projects. It's \$9.95. Dremel, 4915 21st St., Racine, Wis. 53406.

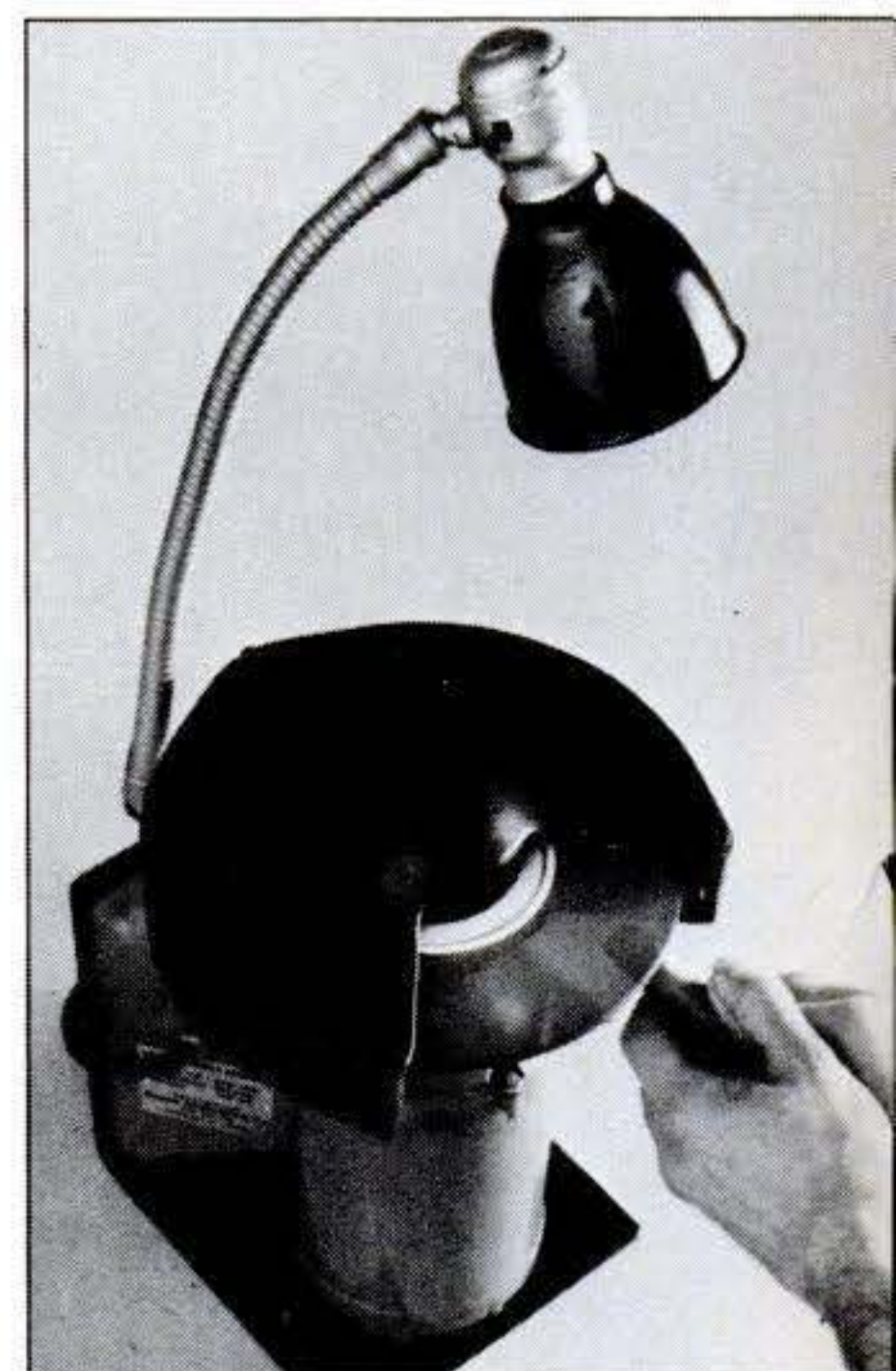


Heat detector

Heat Snoop can measure heat loss through walls and ceilings as well as detect air leaks around doors or windows, the maker claims. The nine-V battery-powered gun displays readings on its meter. \$32. Environment/One, Box 773, Schenectady, N.Y. 12301.

Laser level

Leveling is a one-man job with the EL-1 Electronic Level, the maker says. Small detectors receive invisible light from the self-leveling emitter, signaling alignment automatically with an audio or visual cue. It's about \$2,800. Spectra-Physics, 3333 N. First St., San Jose, Calif. 95134.



Horizontal grinder

At 3,600 rpm the radially slotted wheels of the Visible Grinder become transparent, resulting in better accuracy and safer operation for beginners, says Beaver Engineering (200 Weeden St., Pawtucket, R.I. 02860). Eight-in.-dia. wheels come in No. 60, 90, 120, and 220 grits. The grinder is \$275.

What's New IN HOME IMPROVEMENT

BY PAUL BOLON



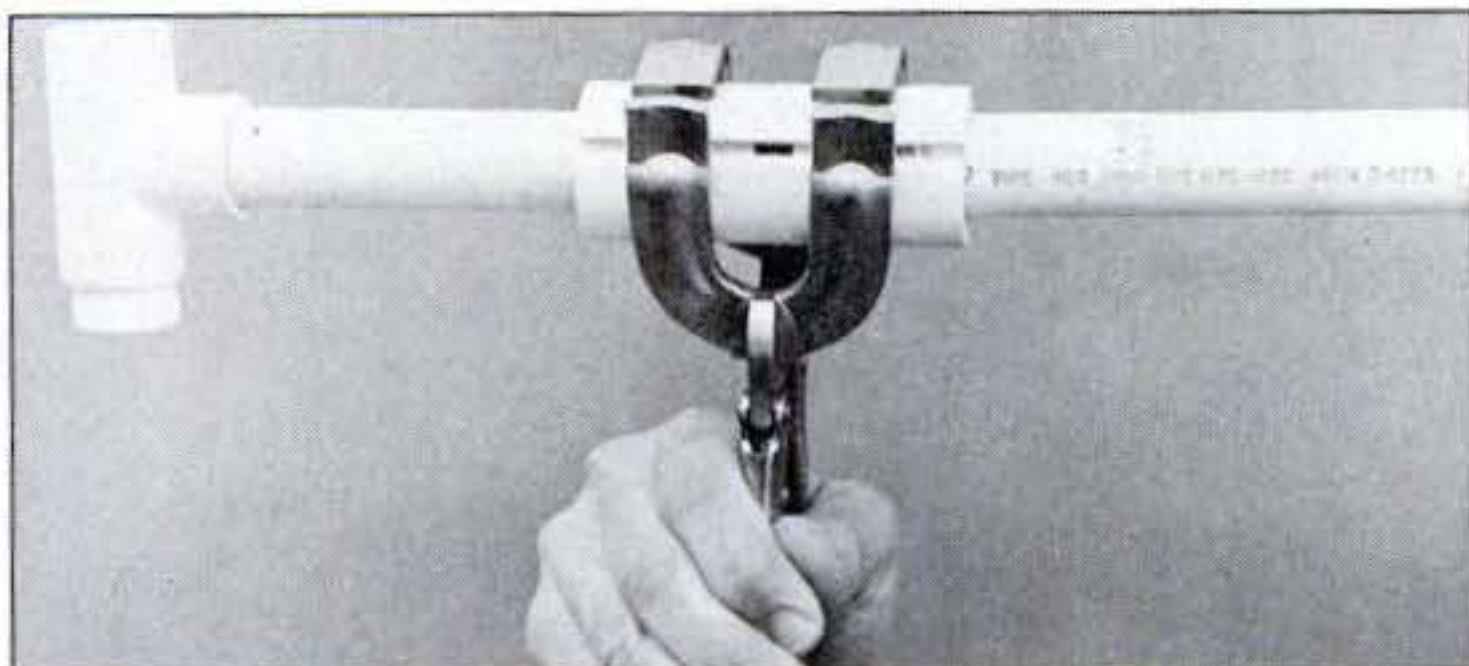
Hex lav

There's a new shape in Kohler's line of decorative bathroom fixtures: the Hexsign lavatory. The six-sided, cast-iron-and-enamel model is available with faucet drillings either four or eight inches apart. Kohler Inc., Kohler, Wis. 53044.



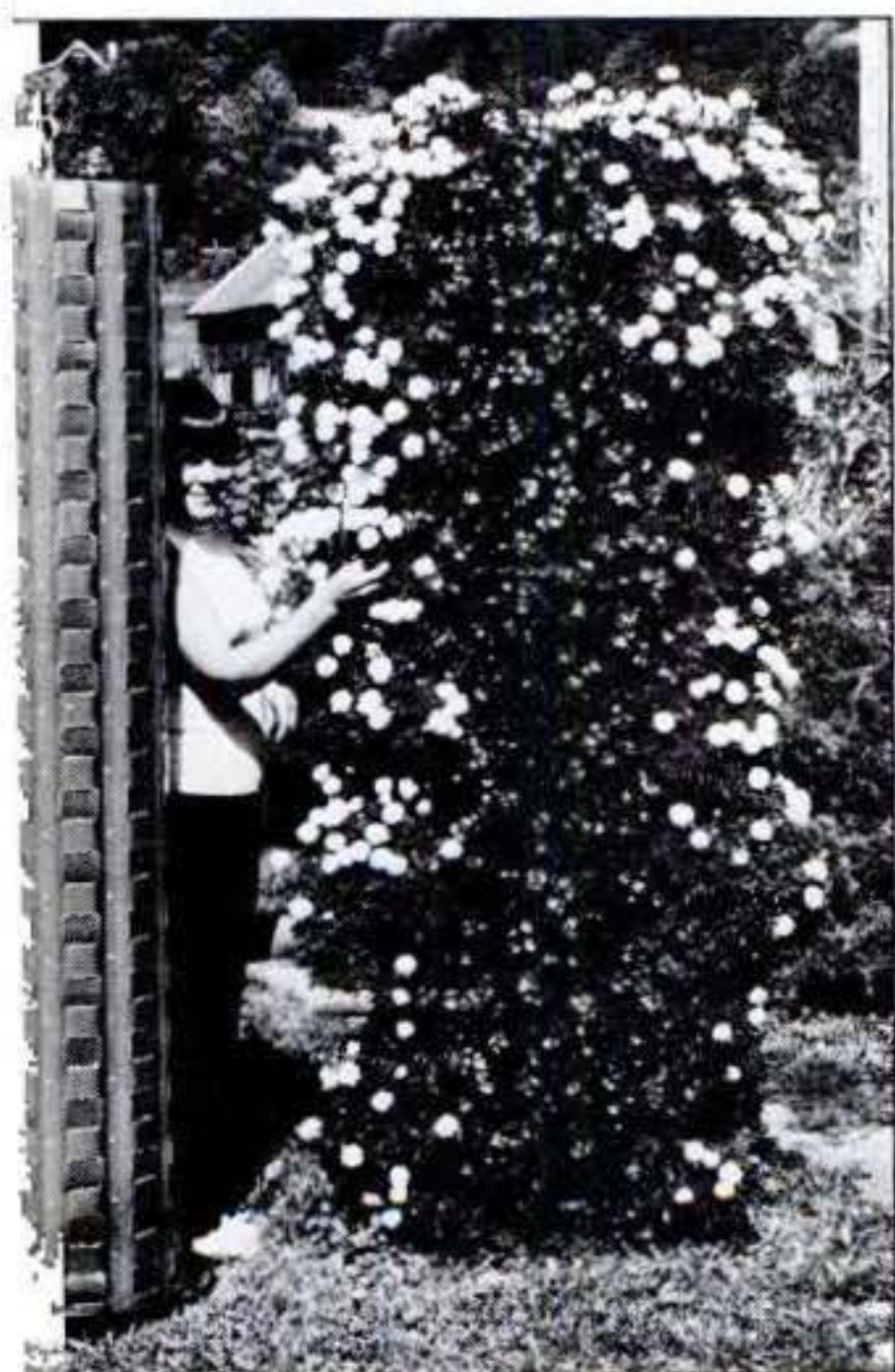
AC adapter

Replacing an old outdoor condenser with a new, more efficient model? You can achieve a higher efficiency rating (and avoid changing the evaporator coils inside) by installing its Thermo-charger in the lines, claims Carrier (Box 4808, Syracuse, N.Y.). Saving: \$150-\$250.



PVC fix

Spread PVC cement on the two halves of the PVC Pipe Patch and clamp lightly—you have repaired a damaged pipe in just 30 seconds, says Tri-Tech Tool (11050 N. 22nd Ave., Phoenix, Ariz. 85029). The quick fix is made for common pipe diameters from 1/2 to 1 1/2 inches.



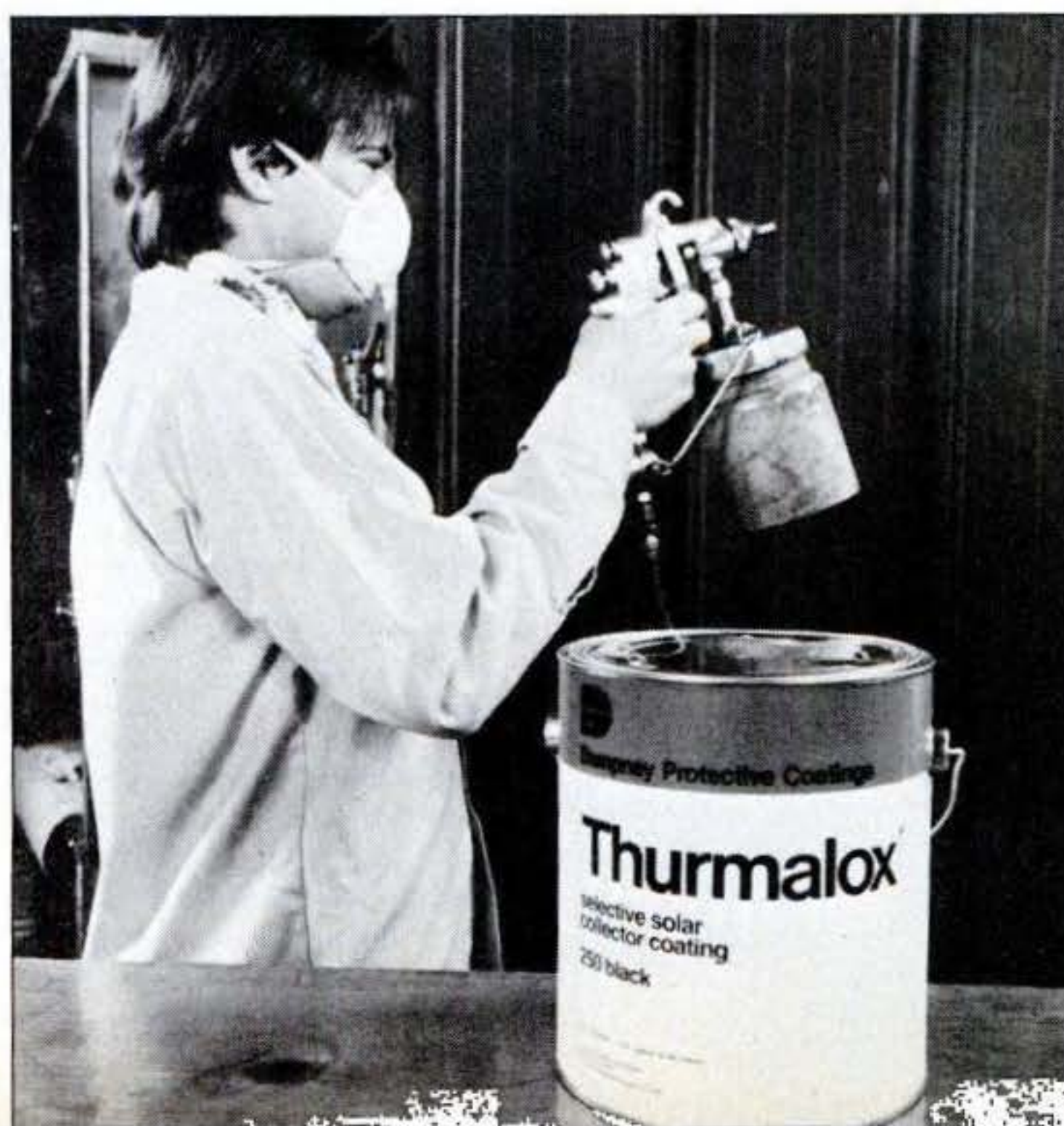
Vertical garden

Short on acreage—or none at all? Consider growing up(wards) with a Living Wall garden. Planting is done by removing a cover and inserting a seed or seedling. The fiberglass containers come in many shapes and sizes. Living Wall, R.D. 3, Naples, N.Y. 14512.



Microwave hood

The MVP (microwave-ventilation product) replaces conventional over-the-range hoods with a microwave oven and two-speed ventilation fan. The hood can vent outside or to an optional charcoal filter. Magic Chef, 740 King Edward Ave., Cleveland, Tenn. 37311.

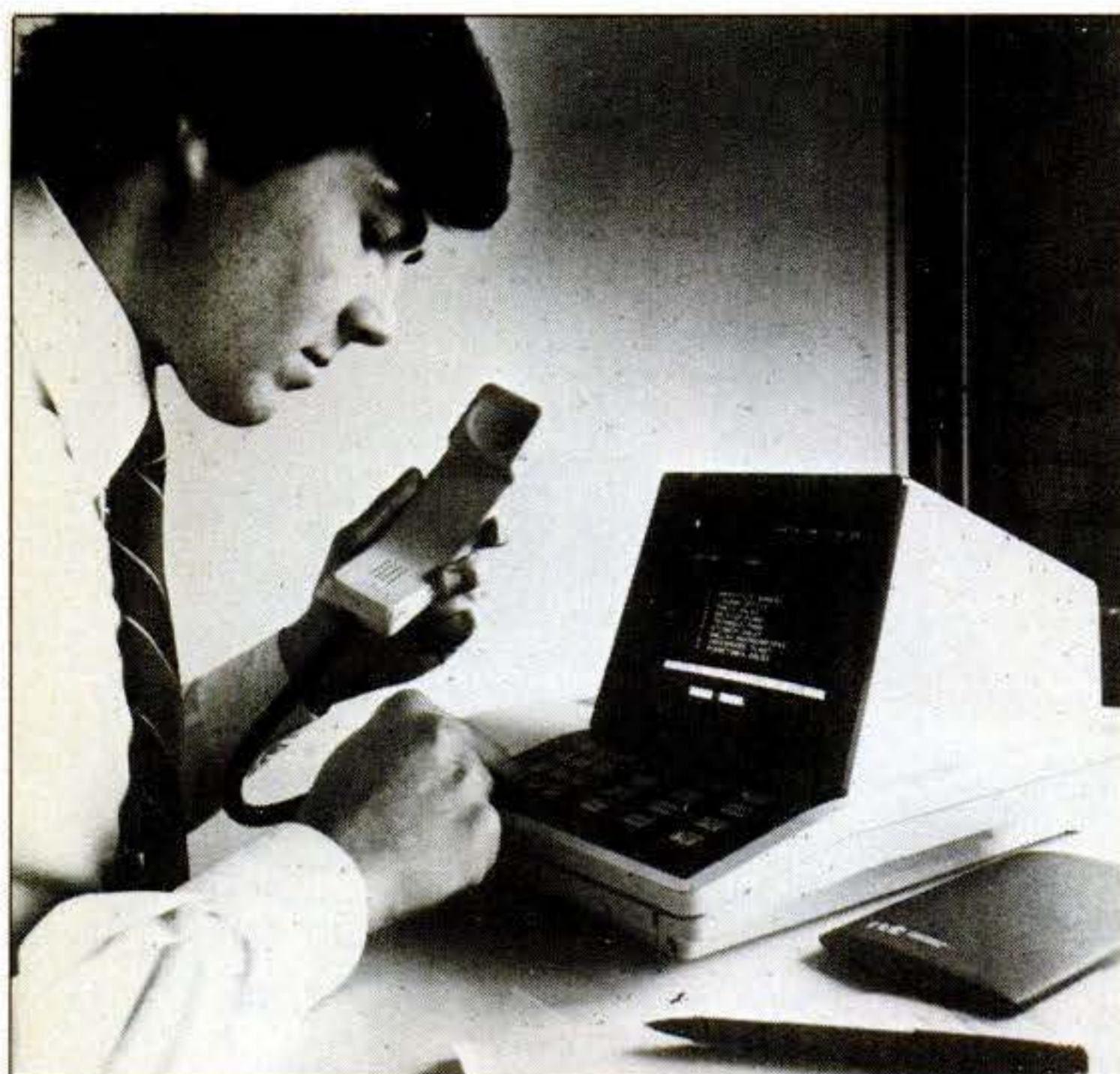


Collector coating

Thurmalox black solar coating selectively absorbs solar wavelengths with the greatest energy, collecting heat more efficiently than ordinary black paints, claims Dampney Co. (85 Paris, Everett, Mass. 02149). The company says the paint resists outgassing and photodegradation by UV light.

What's New IN ELECTRONICS

BY WILLIAM J. HAWKINS



Picture phone

Along with your voice, the Displayphone (left) can send pictures and text over standard phone lines. The desktop prototype shown here may be available in another year, says Northern Telecom, Nashville, Tenn. 37217.

Flip-side player

Microprocessor-controlled turntables give you a hand in programming your music. Sharp's VZ-3000 gives you an arm: A second vertically tracking arm plays the flip side—no need to turn the record over when the first side is done. Price is not yet set.

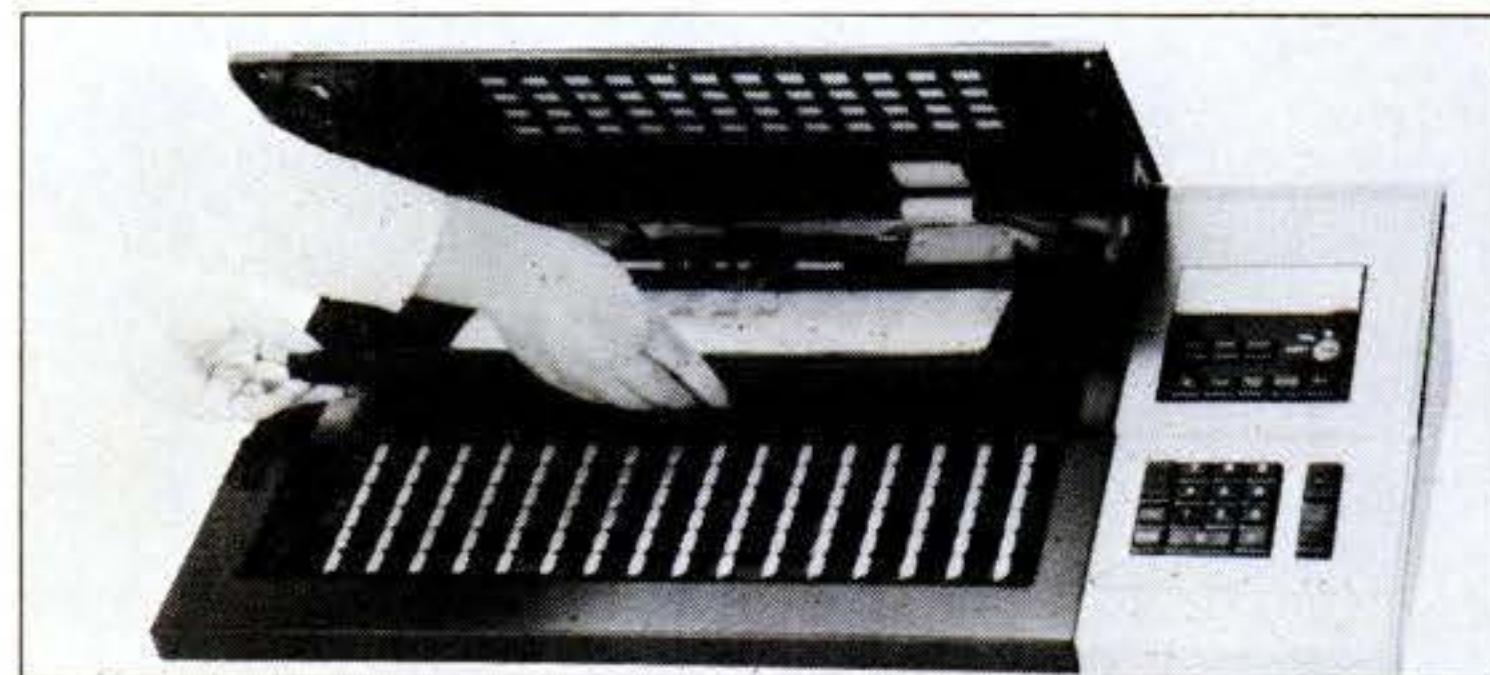


Speedy printer

Attach Radio Shack's Line Printer V to a computer and the result is speed: A bidirectional print head creates up to 160 characters per second using a seven-by-nine-dot matrix. It prints upper and lower case, 26 European characters, and 30 graphics patterns—in four character sizes. \$1,860.

Touch controls

It's small—just 4.7 by 2.4 inches—and it's all electronically controlled. Mechanical switches on the Pearlcor microcassette recorder have been replaced by logic circuits. Result: instant control at a touch. Digital clock doubles as footage counter. Recording time: two hours per microcassette. \$250.



Remote receiver

Touch a button at the console or on the remote control and this Bang & Olufsen receiver readies a turntable, cassette deck, or one of nine FM stations for listening. Volume, balance, tone, and filtering are also remotely controlled. Display shows functions as they are entered. Beomaster is \$2,200.

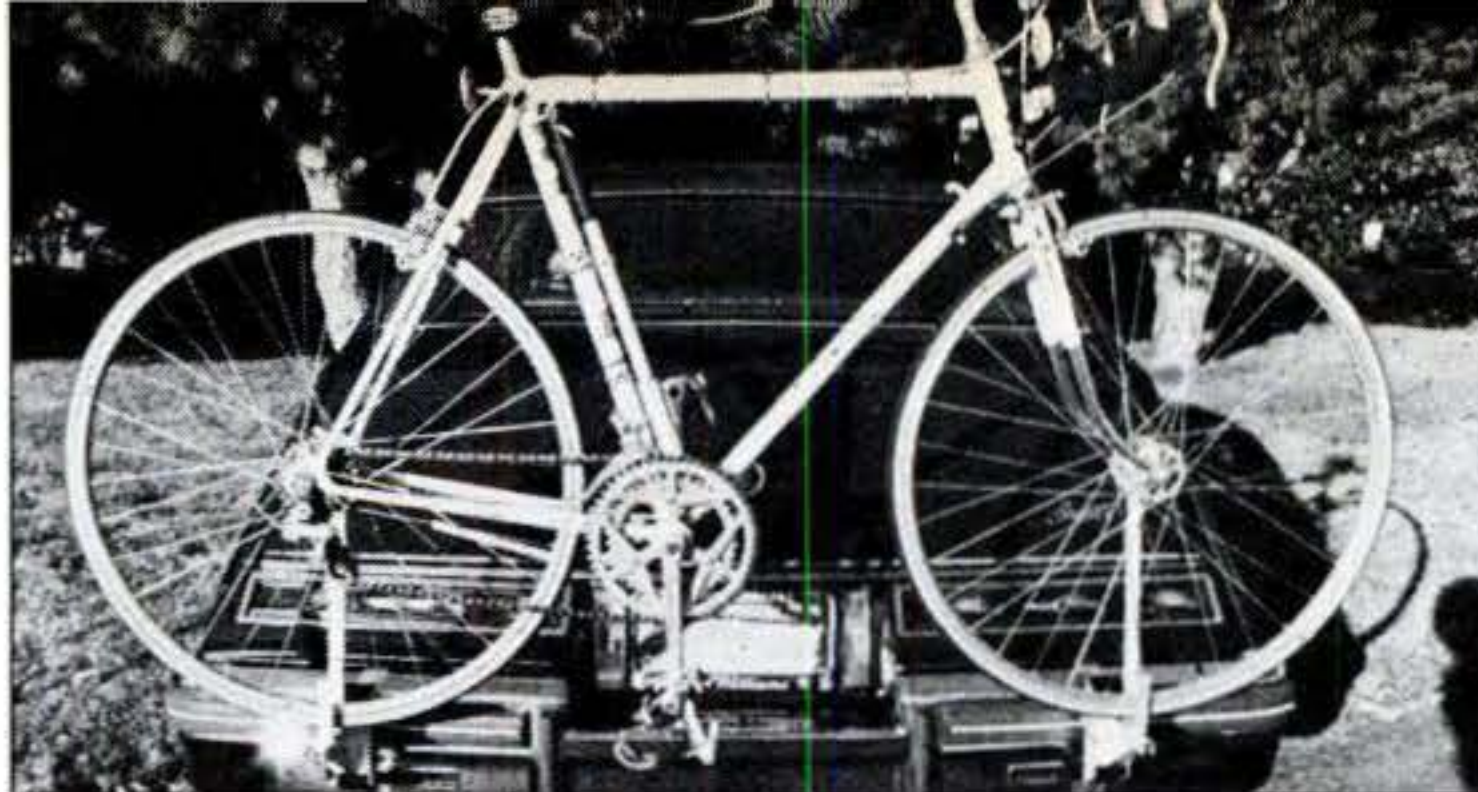
Custom keyboard

What's wrong with a standard keyboard for entering computer data? Nothing, except it's *standard*. So Panasonic has introduced this programmable "key-mat" keyboard. Plug-in cartridges, a microprocessor, and special key legends allow you to customize the keyboard 34,560 ways. About \$1,800.



What's New FOR YOUR CAR

BY ED JACOBS



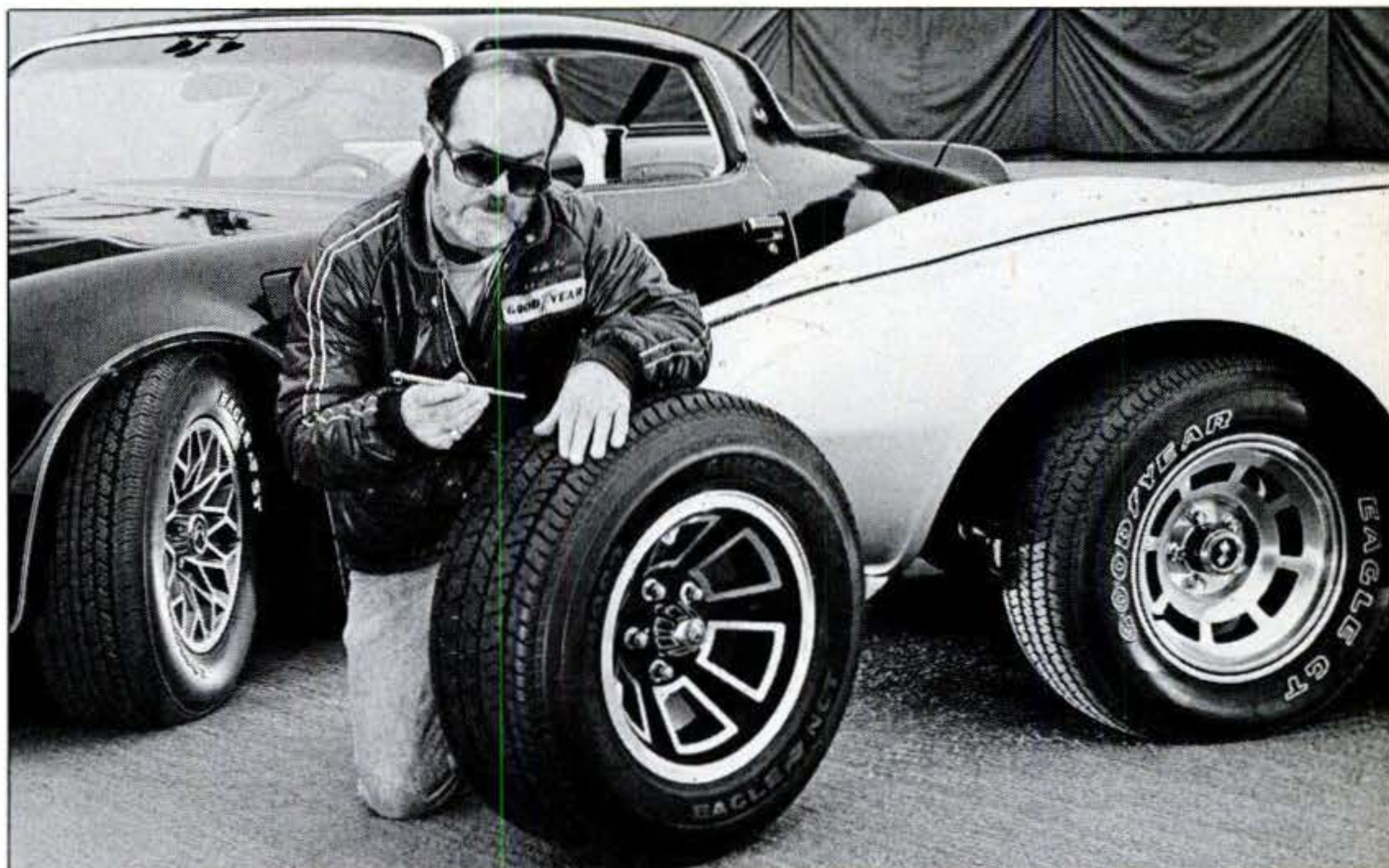
10-speed carrier

JayBar 10 carriers are designed specifically for 10-speed bikes. They're removable when not needed, leaving only bumper-guard-like mounts. Prices: \$39.95 (one bike) and \$49.95 (two bikes). JayBar Carriers Inc., Box 6043, Santa Barbara, Calif. 93111.



Transmission filter

Automatic transmissions require very clean fluid. Hayden's add-on, in-line Trans-Filter kit is said to give two to five times the filtering efficiency of a transmission's built-in unit. Hayden Inc., 1531 Pomona Rd., Corona, Calif. 91720. Cost: \$19.95.



High performers

Goodyear's Flexten-belted Eagle NCT (center) is derived from the European-designed Neutral Contour Tire that is standard on certain European high-performance cars. The Eagle GT (right) is steel-belted and has the same tread pattern as the Eagle NCT, but with raised white lettering added. The Eagle ST (left) is fiberglass-belted, has raised white lettering and the tread pattern of the Customgard GT Radial. It is intended for high-performance applications on cars, vans, and RV's.

Tire inflater

Need air? Attach Tirite's hose to your tire and press the buttons for the right pressure. Electronically controlled, it inflates your tire to within a few tenths of a psi. Forecourt Automation Ltd., Pennygillam Ind. Estate, Launceston, Cornwall, England.



Swiss timers

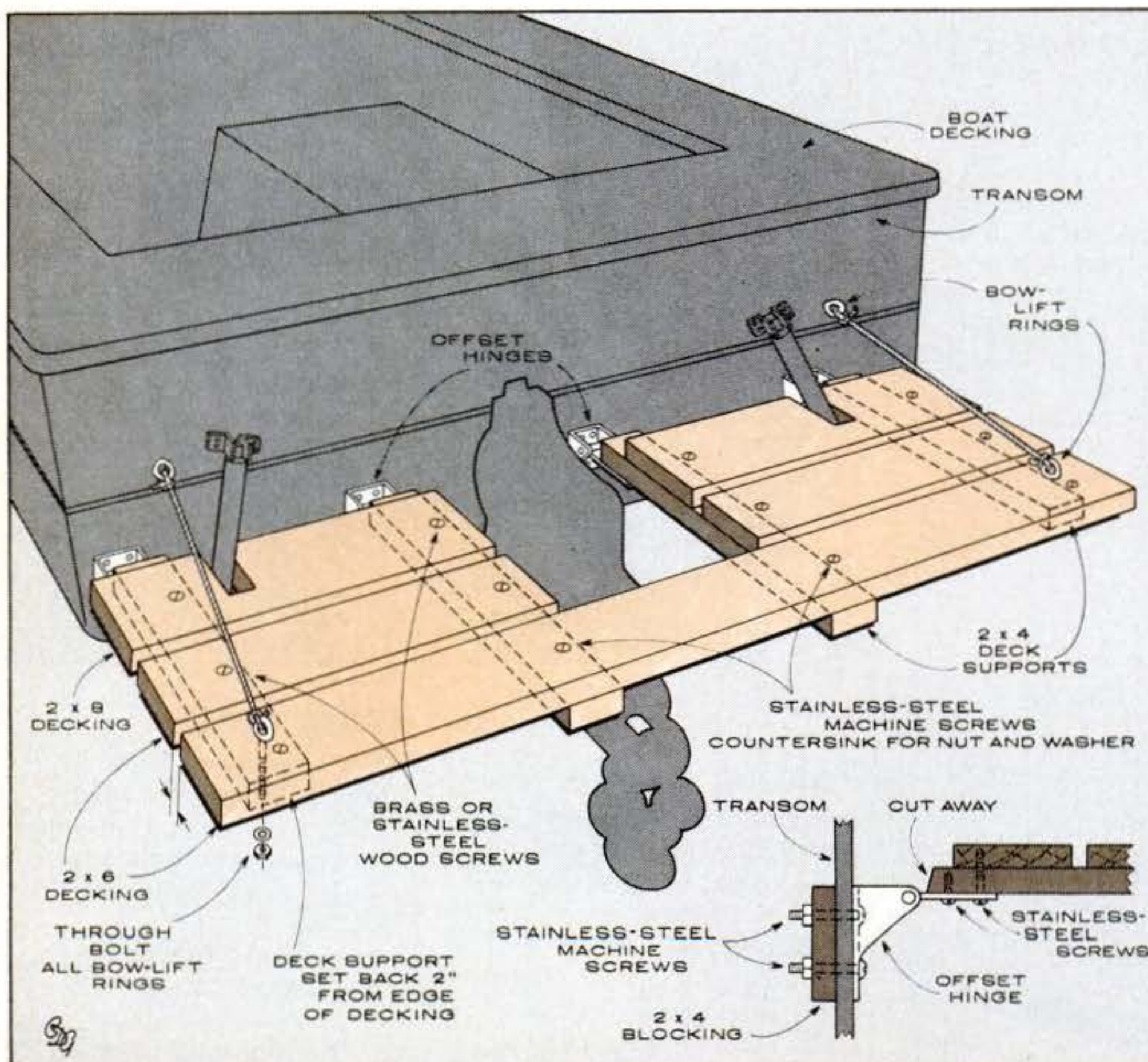
Heuer's family of dash-mounted timers has analog or digital readouts, time-out and safety-reset functions, and zero-to-60-minute or 12-hour central recorders. They're priced from \$100. Heuer Time & Electronics Corp., 960 S. Springfield Ave., Springfield, N.J. 07081.

Folding trailer

Despite its 950-lb. load capacity, TricTrailer is only 20 inches wide when folded for storage. Casters let you roll the folded unit around. It's available as a DIY kit (\$439) or fully assembled (\$489). I.S.E., Inc., 1009 Grant St., Denver, Colo. 80203.



Drop-leaf swim deck



By J. R. HOLT

Out on a lake, swimming from a run-about results in a lot of rocking and sloshing as bathers climb back aboard—even with a ladder slung over the side. My solution is a wooden swim deck hinged to the transom. The deck swings up and out of the way when the boat is moving. Materials for the deck (see drawing) cost about \$50.

The deck makes swimming more enjoyable and, I think, a little safer. And faced with ever-higher fuel prices this summer, boat owners will be indulging in a lot more "at-anchor" activities such as swimming. **P 5**

Position the swim deck at or just above the waterline on the boat's transom. The size of the cutout for the motor depends on whether you have an outboard or stern-drive unit—in any case you'll have to adapt this basic design to your own rig. One-inch hardwood boards can be substituted for the two-inch pine deck lumber shown here. The deck's depth should be less than the distance from the hinge to the top of the transom. Offset or hatch-style hinges allow ample clearance between the deck and transom.

Give your rooms sun control and elegant customizing with **Easy-to-install mini-blinds**

Toss out dusty drapes, end curtain clutter: Mini-blinds do the whole job better

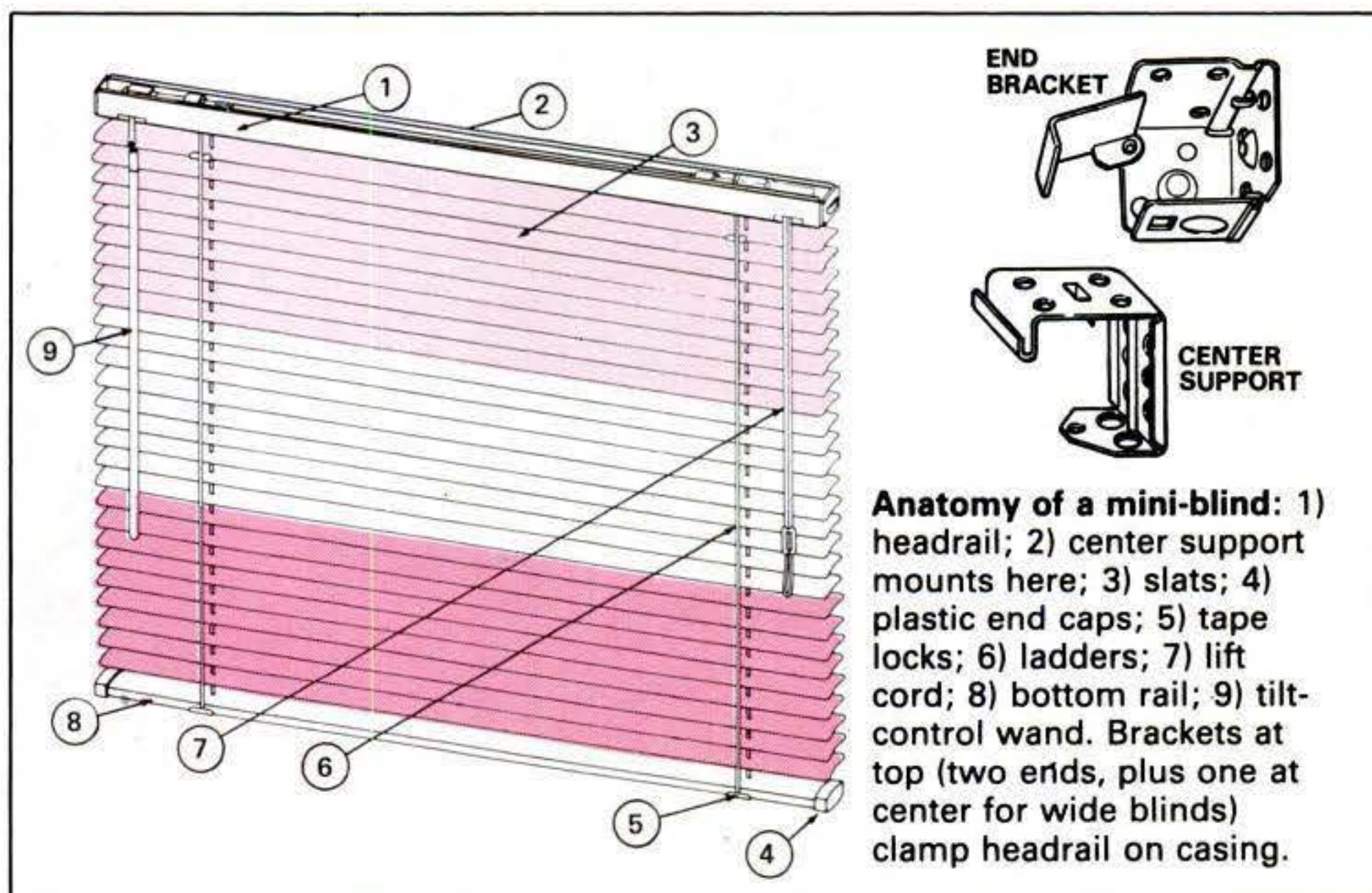
By AL LEES

They're a classy update of the Venetian blind, but their arched slats are paper-thin aluminum and only an inch wide. And you can customize them in an array of baked-on colors that make draperies redundant.

Mini-blinds are as functional as they are handsome, offering not only privacy but precise control of ventilation and solar exposure.

Do as I did and order all color bands in duotone slats (color on the front, white on back) and you've got an effective shield against unwanted solar gain this summer. Pivot the slats to their opposite extreme on winter nights and you'll bounce indoor heat back from wasteful contact with cold glass. And when you *want* solar heat to flood your room, tilt the slats to match the sun angle—or stack them all neatly at the top of the window casing by tugging the lift cord.

The blinds are a cinch to install [PS, Nov. '80]—either within the casing, as in most of our color shots, or overlapping it. Remember, all these blinds are custom-made and can't be altered once they're assembled. So measure and order carefully—especially for mounting within casings. Blinds come as narrow as 12 in. or as wide as 142 in. Any width of 55 in. or more should have a center support bracket. For narrower blinds, the two boxlike end brackets suffice. They come with screw holes in three faces so they can be mounted to the face of the frame, within the sides, or to the ceiling. Headrail slips in, lids snap shut. **P.S.**

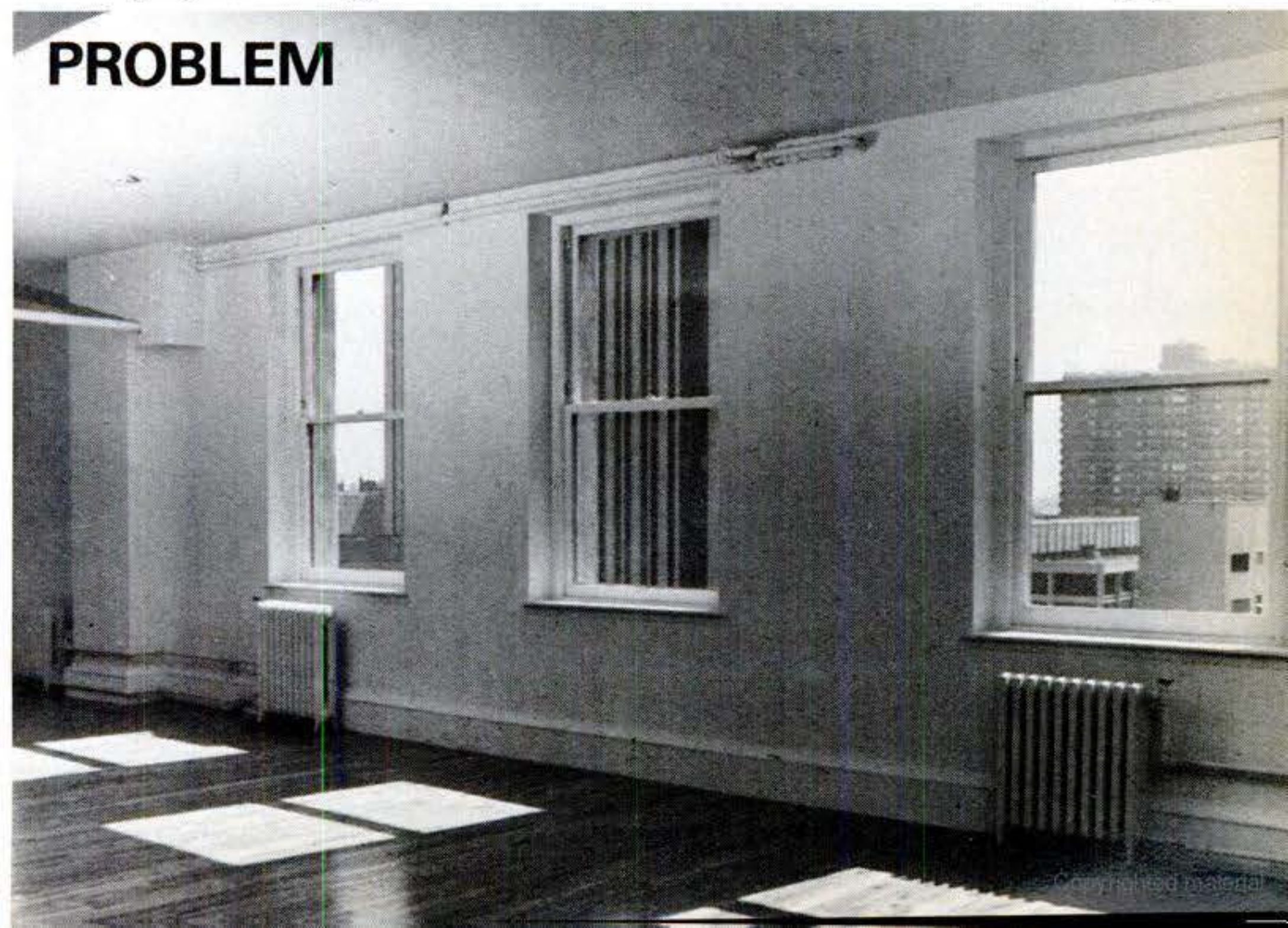


Outsized and irregularly spaced windows created awkward wall in author's loft and were single-glazed energy-wasters. Uni-

fying draperies would have cost a fortune and been clumsy to open for view.

For mini-blind solution, turn page

PROBLEM



SOLUTION



Identically striped blinds in six colors unite windows. Graduated effect, with

bands narrowing as they darken in tone, is even more pronounced at night. All slats

have off-white backs, which bounce out summer solar heat. Blinds by Flexalum.



LIVING ROOM

Another example of carry-across stripes is designer Ann Heller's room for Levolor with a stair-step of bold colors across an off-white ground. Here, "duotoning" (white backs) wasn't needed.



STUDIO

Single slats of darker color are matched by window frame to dress up this window without counter-space-wasting curtain. Designer Margot Gunther uses kitchen cabinets for storage.



KITCHEN/DINING

Super graphics unite kitchen with adjacent dining alcove. Green and plum diamond, wrapped around corner, picks up colors striped across both Levolor blinds. Hang blinds before striping.

Two major makers of mini-blinds: Levolor Lorentzen, Inc., 1280 Wall St. W., Lyndhurst NJ 07071 (offers \$1 color booklet "Window Magic"); Flexalum Decor Blinds by Hunter Douglas Inc., 20 Campus Rd., Totowa NJ 07512 ("Measuring and Installing" booklet, \$1). Neither booklet includes chips of many colors available; ask for price of sampler kit or address of nearest dealer.

Mini-blinds also solve non-window problems



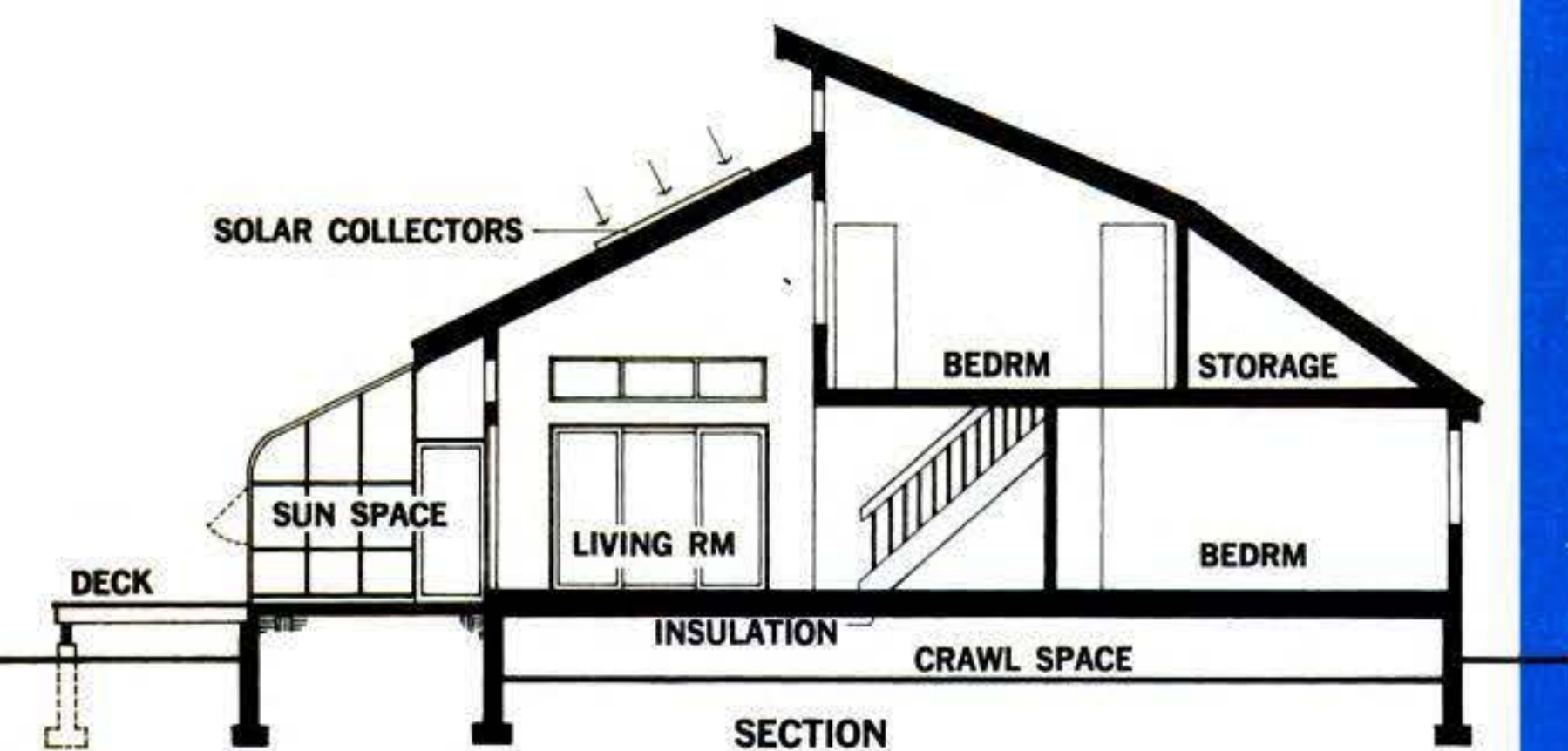
Pullman kitchen tucks behind floor-length blind that's easily raised for access to

work counter. At right, narrow blinds are mounted within room-divider frame to

screen off dining area without losing air circulation. Both settings by Flexalum.

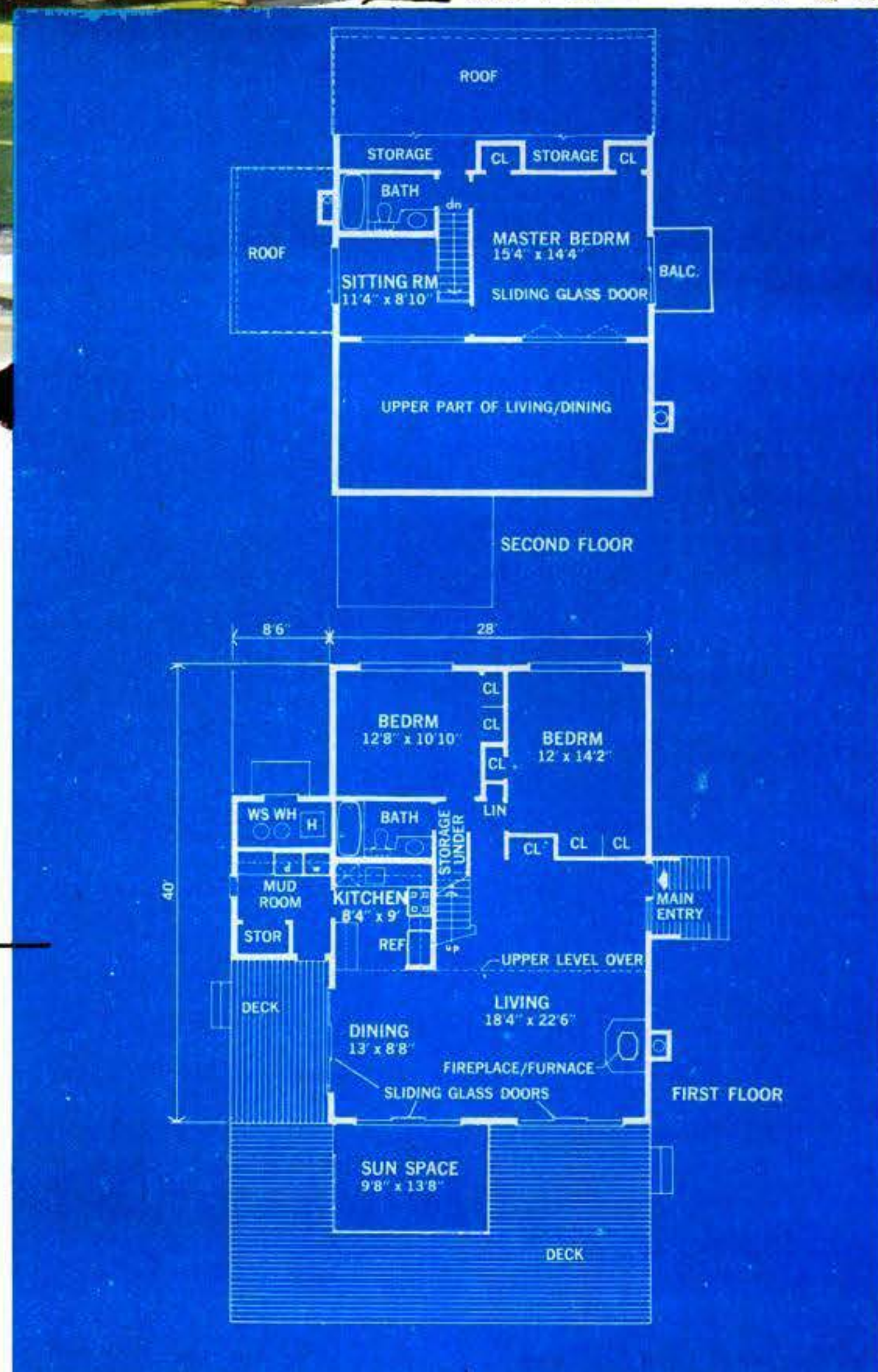
PS leisure-home plan

Solar-room retreat



How to order your plans

One set of detailed, professionally drawn blueprints for this house is \$85; five sets (for construction, financing, obtaining permits), \$115; materials list and specifications included at no extra cost. An additional mirror-reverse print can be ordered for \$10. Address orders or queries to Homes for Living, Inc. (specify Lakeland Plan), 107-40 Queens Blvd., Forest Hills, N.Y. 11375. Add \$4 to all orders for postage and handling.



By AL LEES

The home greenhouse has changed its image drastically in the last three or four years. It's been demonstrated in hundreds of installations that an attached greenhouse that is properly sited on an unshaded south wall can contribute dramatically to the passive solar gain of almost any home.

That eye-catching glass shed is no longer just a hothouse for plants, but an environment for people. The popular new term for such an appendage is "sun space," and many new homes—such as the Lakeland, left, designed for PS by architect Samuel Paul—are literally built around such commercial units.

In our example, the sun space seems to sit on a broad wooden deck. Actually, the deck is built around the greenhouse's concrete slab faced with quarry tile. In winter, this masonry mass soaks up solar heat and transmits it to adjacent rooms. Heat flow can be controlled by opening the sliding glass door that seals this space off from the living quarters. At night, this double-glazed door is closed, and the sun-warmed slab gradually releases its heat to keep the space cozy. The only time the greenhouse would require backup heat (if you wished to sit there or leave plants out) would be after several sunless days.

A standard commercial lean-to has been customized with a strip of screened awning-type windows around all three sides, as shown in the inset, top left. When opened, these panes create a breezeway. On bright summer days, insulating shades are pulled down overhead, and an exhaust fan, placed high in the corner of one glass wall, expels warm air. This greenhouse can truly be enjoyed as a kind of outdoor space that's available in all weathers, which makes it an ideal feature for a year-round leisure home.

The house has additional energy-saving aspects: Mounted on the roof above the greenhouse are two solar collectors that provide domestic hot water. The storage tank is located (along with a conventional water heater and backup furnace) in the utility area behind the mud room. And those clerestory windows tucked just under the ridge siphon off hot air in summer. Finally, to further cut dependence on fossil-fuel heat, there's a prefab heat-circulating fireplace-stove in the living room. A siding-sheathed chase for its metal chimney adds architectural interest to the exterior. So does that half-gambrel roof line, which also provides head room for upstairs storage.

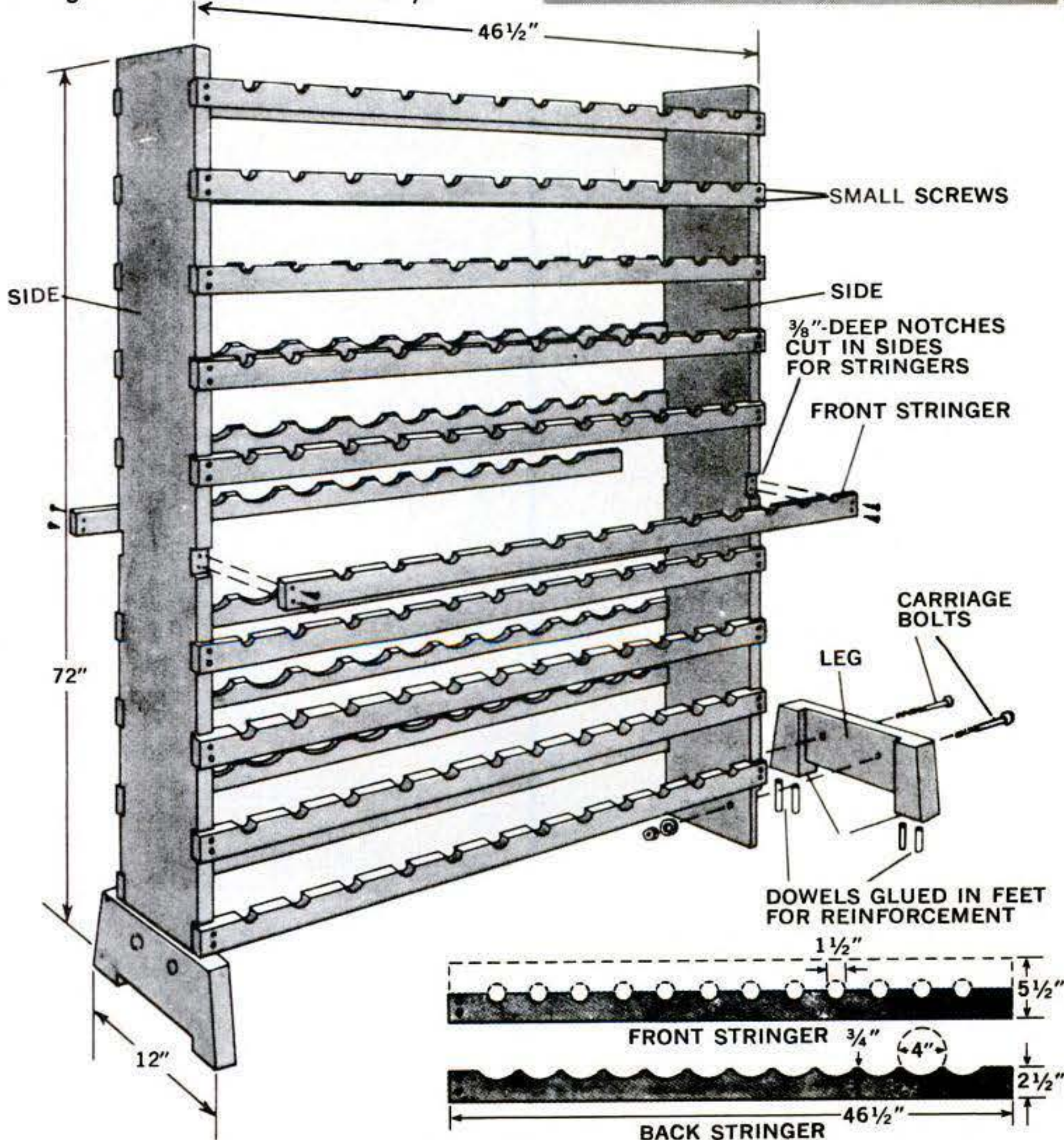
PS

A wine rack that will last

Wet wood and crumbling cardboard—that's the usual result when you try to store crates or boxes of wine (or other beverages) in a cool cellar or other occasionally damp spot. Here's a solution: a wine rack made of redwood, which can endure damp storage environments and is big enough for the ambitious collector or bargain hunter. The rack is built of common-size lumber, using standard hand tools.

The design calls for two sturdy 2×8 feet, half-lapped to the base of the uprights and reinforced with glued-in dowels for extra strength. But if the joists in your basement ceiling are exposed, just make the rack's sides tall enough to tie into them for greater stability. No wood finishing is necessary.—Paul Bolon

Front stringers of rack are fashioned by boring holes in 1×6's, then rip-sawing the boards in half. Scallops for the back stringers must be cut individually.



Cutting a roof truss

How to do it without bringing down the house

Brace them and box them—*carefully*—to open up new bedroom space

By PAUL BOLON

CONCEPTS AND SKETCHES BY CARL DE GROOTE

You expect to see waves at the seashore, not on a living-room ceiling. But incredibly, they were there. I was standing in a house in New Jersey, and the ceiling above my head dipped up and down like a roller coaster. It

was not a new decorating effect, but a small disaster.

A contractor had cut several of the ceiling joists to make a stair opening to the attic. But those weren't merely ceiling joists that he'd cut; they were the bottom chords of roof trusses. When the chords were cut, the ends pulled apart and sagged.

The strength and balance of a truss are dependent on each structural member. Most of us know not to violate the framing of a truss. Yet almost all tract-built homes are now constructed with trussed roofs, and many

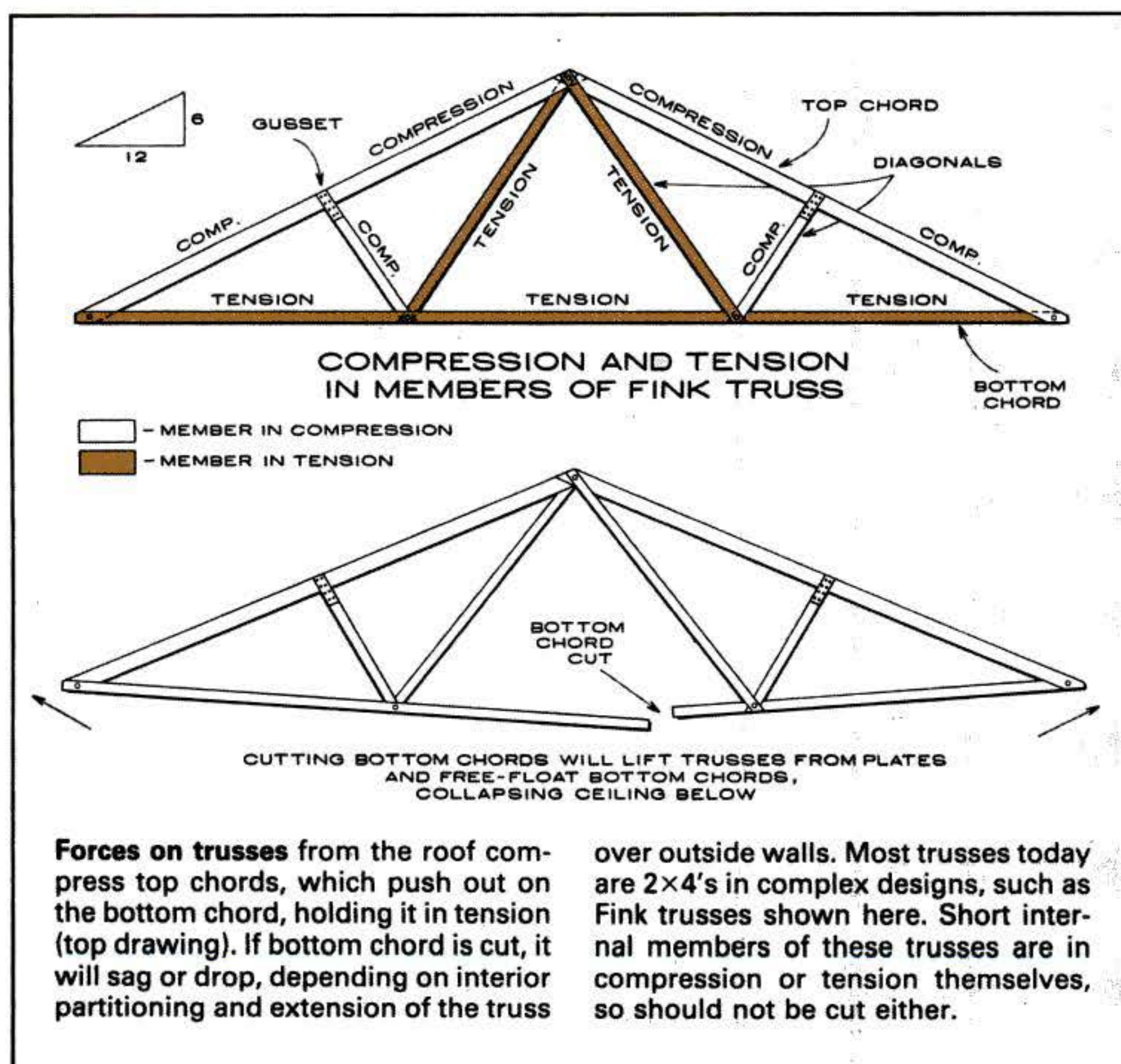
of these houses—like the one I just described—are built on slab-on-grade foundations. So people often turn to their attics to find extra storage or living space. Installing a skylight window in a trussed roof involves the same problem of altering trusses (see drawings, opposite page).

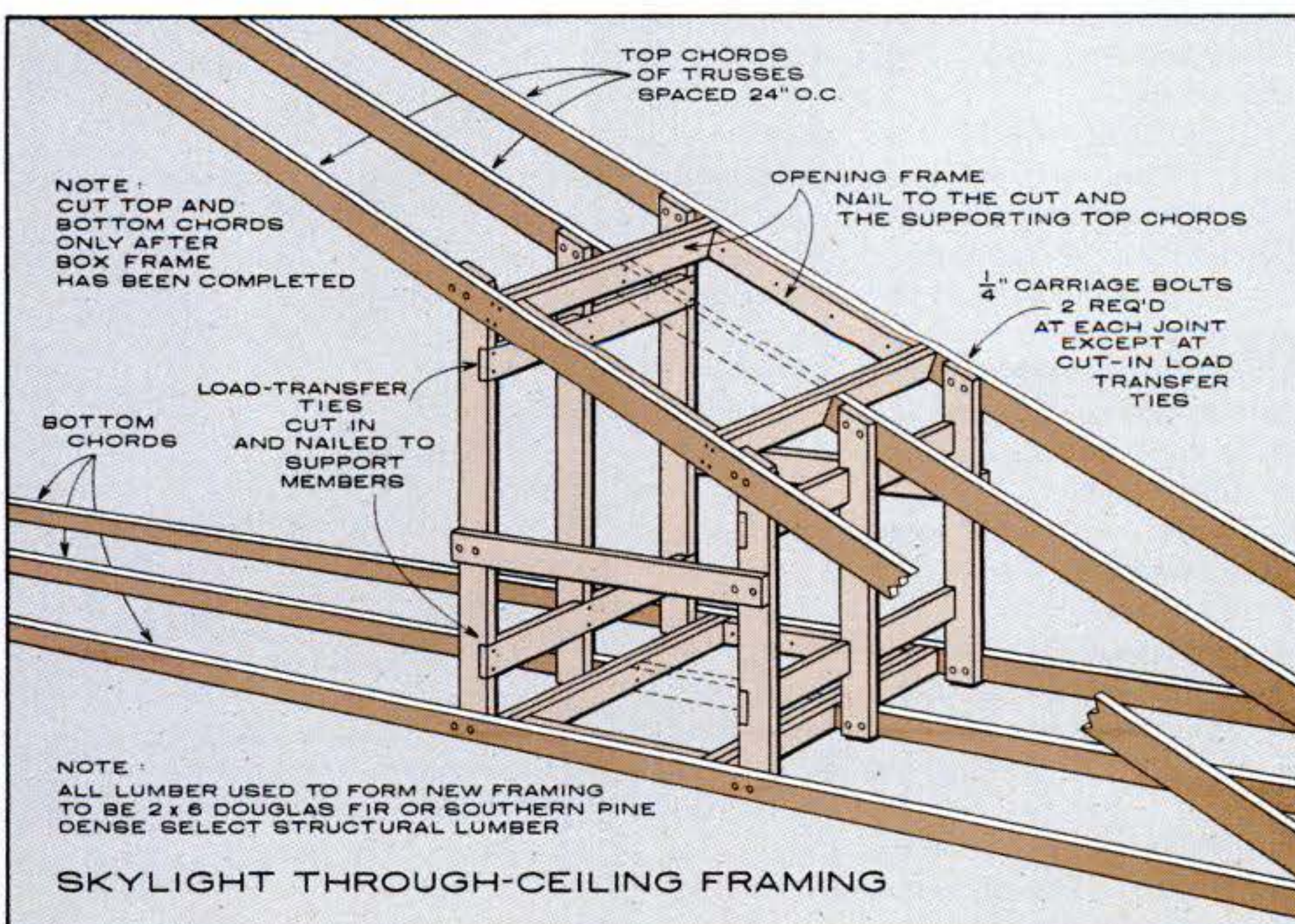
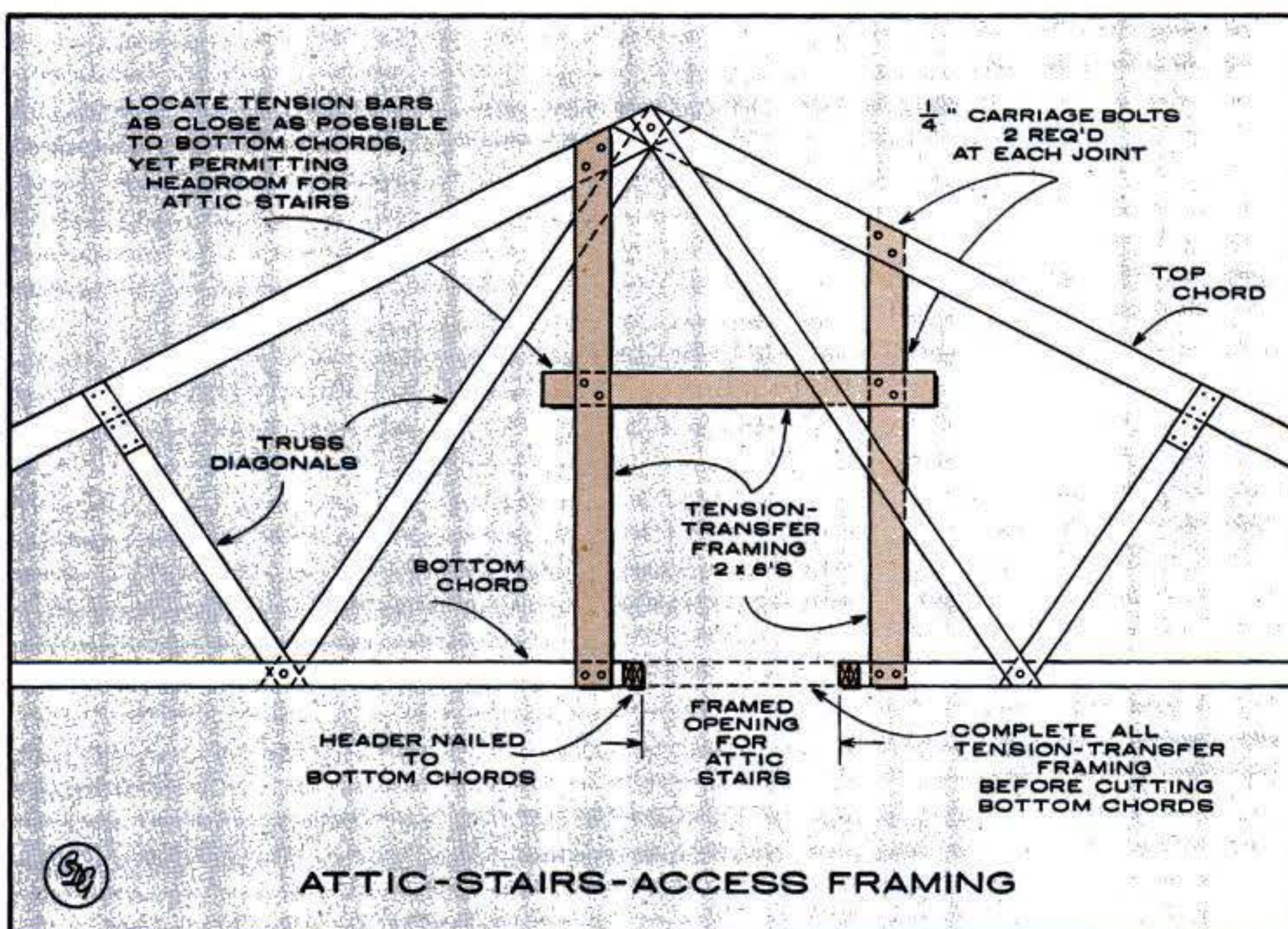
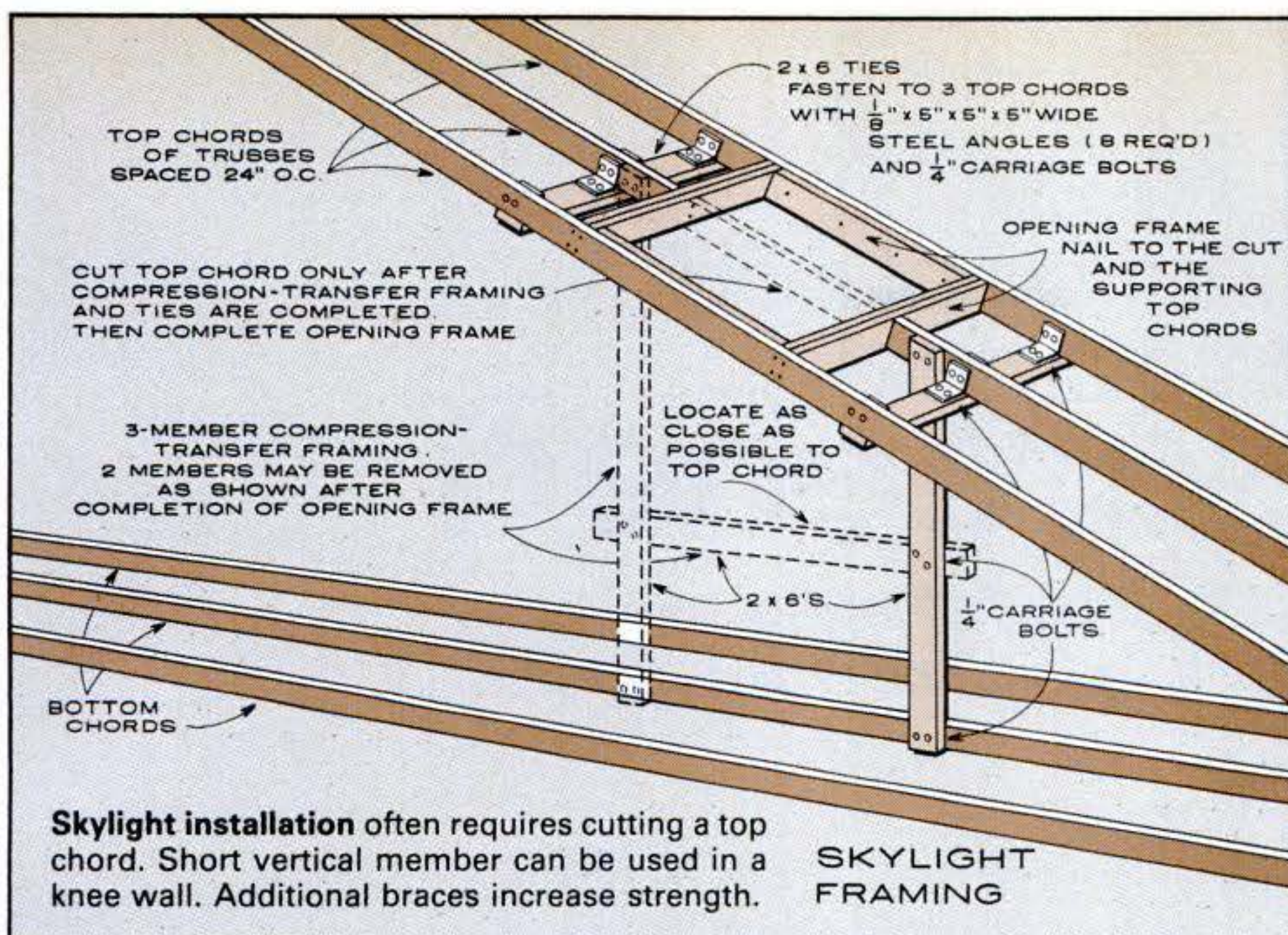
Does truss construction mean that the attic is unusable, entirely off limits? The answer is no—not if the truss is redesigned in the right way and carefully reconstructed. The secret to cutting a truss successfully is to build a box around the cutout piece. The box will bridge around the gap, rejoining the cut member. But the box must be designed so it reacts to roof forces in the same way as the missing truss piece. The box must transfer the forces to keep the truss in balance.

Basically the top chords of trusses are in compression from roof loads (roof weight, snow, and wind), and they push out on the bottom chord, putting it in tension (see drawing). Most trusses in new homes are complex in design, and have short internal members. Plywood or metal gussets secure the joints between truss members.

There is an appropriate box design for cutting either a top chord, bottom chord, or both (see drawings). Before any truss is cut, the truss members and gussets should be inspected. If they are sound, the truss must be thoroughly braced—both internally as well as to several adjacent trusses on both sides of the cutout.

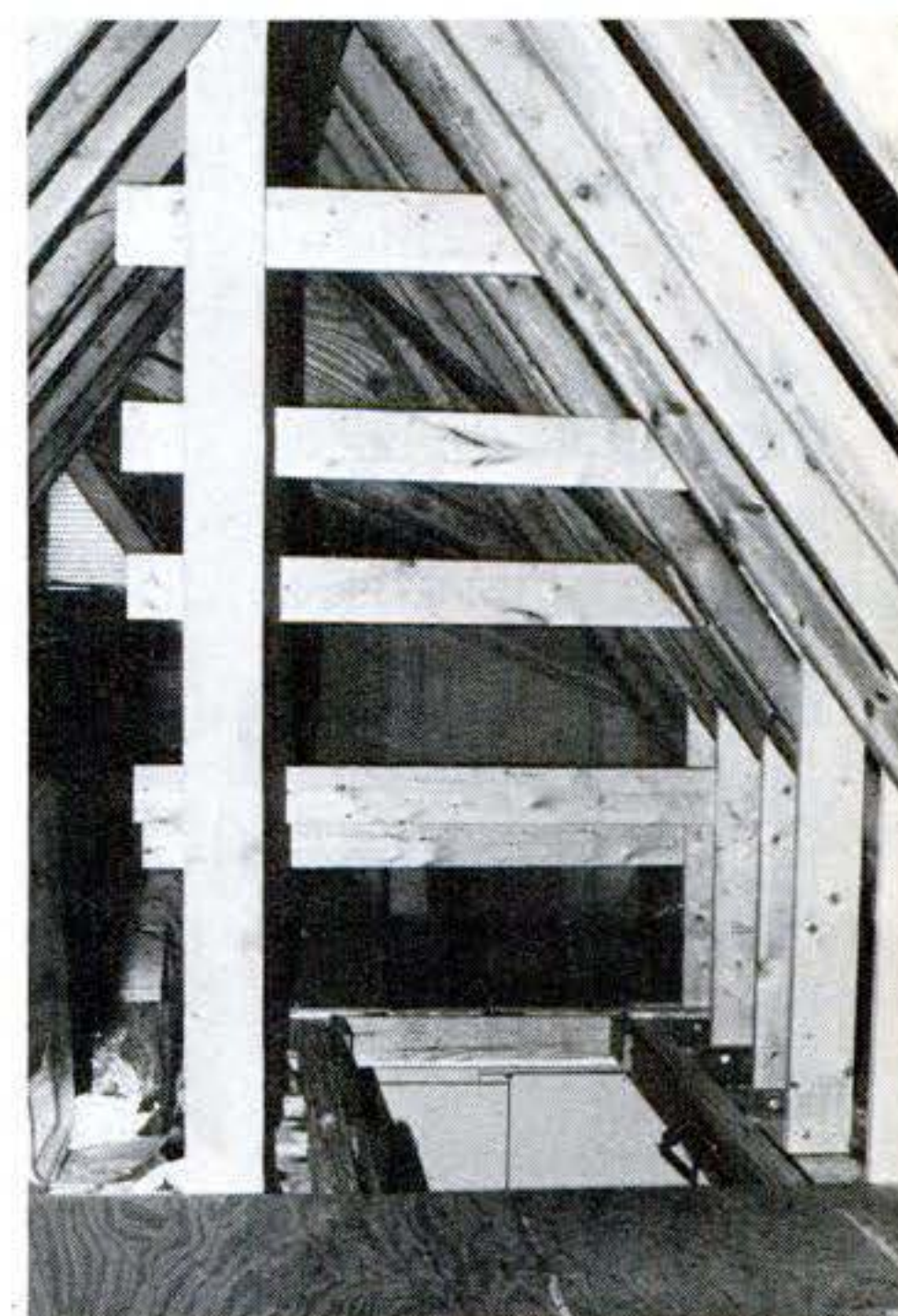
After bracing and cutting the truss, the box can be built. Particular care must be taken at joints on a bottom chord, because that chord (in tension) will be pulling away from the box. Lumber and truss members are dou-





ble-bolted, not just nailed, at all box joints. The braces can be removed only after the box is completed.

Complex-shaped lightweight trusses divide attic space awkwardly, and they can bear only limited amounts of weight. If you have some usable area between truss members, it doesn't mean that the 2x4's or 2x6's of the bottom chord will permit heavy storage or use as a living area. How much weight a bottom chord can bear depends on the dimensions of the lumber, spacing of trusses, truss design, and supporting-wall partitions from the floor below. Before starting a truss project, check with an architect or engineer to determine the limits of attic use, and work from professionally approved, detailed drawings. **15**



Bottom chords of several trusses can be cut to install a staircase (photo above). Vertical and horizontal box members (drawing, above left) were used to continue tension across the bottom chord of Fink trusses. Only Douglas fir or other dense, select structural lumber should be used as framing for any of the box configurations.

Cutting both top and bottom chords requires building the most complicated type of box (drawing at left). Such a box would serve when adding a through-the-attic skylight in a shallow-sloped roof. In new construction, it would be simpler just to double the adjacent trusses. Lining the box walls with plywood will strengthen it.

Turn a hot slab into a cool **screened porch**

**Make shade, not heat:
Shelter your patio with
this easy-to-build porch**

By BOB GAILOR

PHOTO BY THE AUTHOR

"And the sliding doors open onto your patio!" the salesman said.

"Some patio," I muttered to myself. "A 10-by-14-foot slab of concrete."

Nevertheless, I bought the house. As the subdivision filled in, most of my neighbors contracted for screened aluminum porches. These give their owners a place in the shade and are fairly durable.

But they all look alike, and the prices are anywhere from \$1,500 to \$2,500. If I had wanted to spend that kind of money, I would have had the original house contractor add the porch so I could include it in the mortgage.

Just one hot and buggy Florida summer convinced me of the need to change my patio into a screened and covered porch. Since aluminum kits were expensive (and I could hear the rain's rat-a-tat on my neighbor's metal porch roofs from my own living room), I designed and built mine of wood. The total cost was about \$500, even though I used expensive pressure-treated lumber.

Although it could have been enlarged, the size of the patio slab was the governing factor for the size of my porch. I made the walls tall enough to just fit under the overhang of the roof. Tying the 2×6 porch rafters into the house roof gave the slope needed for rain runoff.

The porch walls were made of 2×4's, with spacing of the studs and horizon-

tal pieces varied for decorative effect. The vertical members of the long wall transfer the roof weight to the ground, and they must extend the full height of the wall.

Each wall was built on the ground as a unit. I found that my neighbors still retained the pioneer "house raising" spirit: There were more than enough volunteers to assist me in raising the completed walls. As the walls were lifted into place, they were braced, nailed together at the corners, and anchored to the slab with ¼-in. bolts. I had previously drilled into the slab with a carbide masonry bit and installed lead anchors every two feet along the sill for the bolts. The frame walls were tied into the concrete-block house with the same technique.

The 2×6 rafters were cut to fit the pitch of the house roof (see drawing) and notched to rest on the long 2×4 wall. These rafters were secured to the house roof and the 2×4 wall with metal angles.

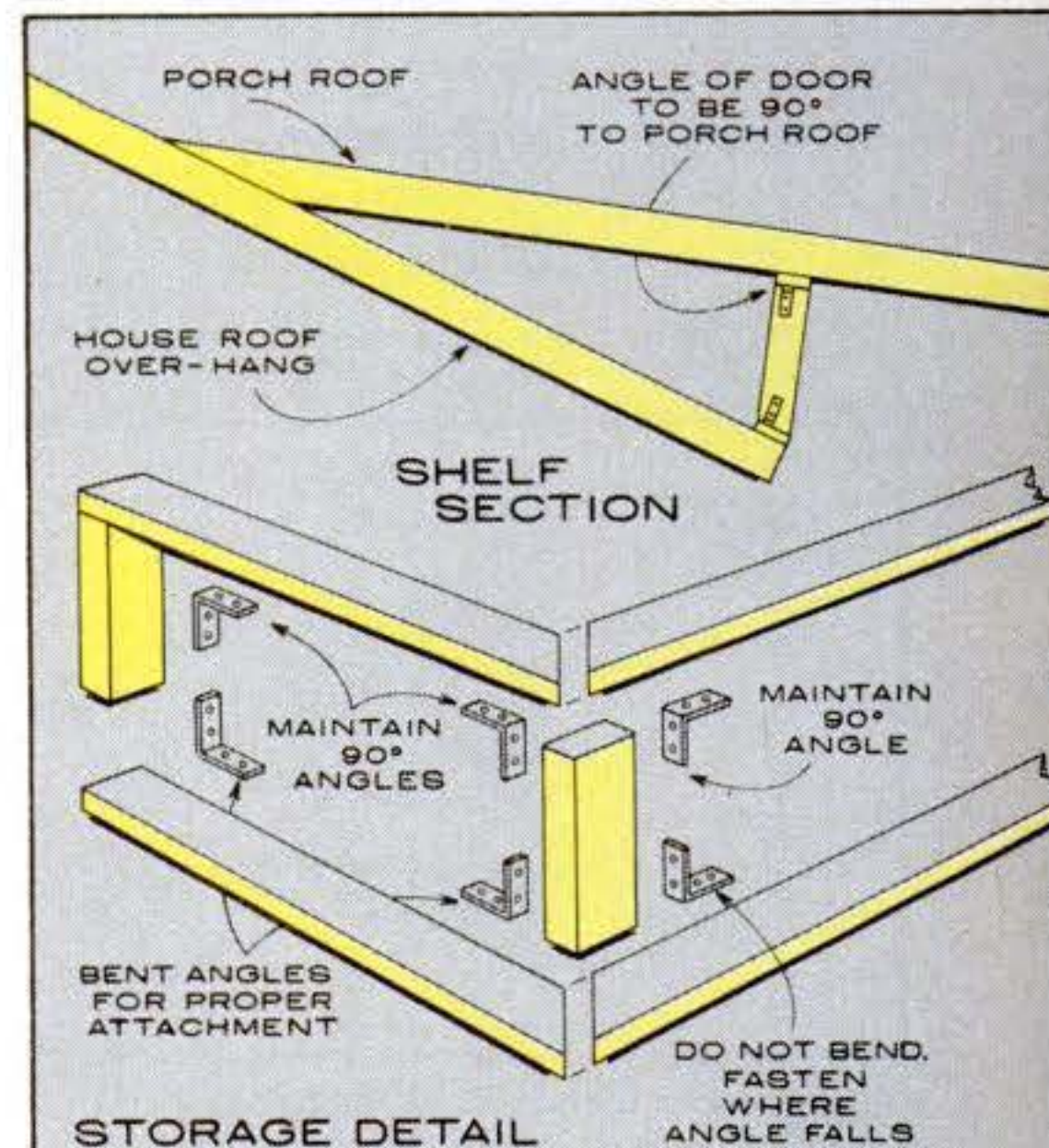
Sheathing for the roof was ½-in. exterior plywood, which was extended a foot at each end of the porch and supported by 2×4 "lookout" rafters. One-by-eight fascia capped the end of both the main rafters and these lookouts. One-by-tens were nailed on the underside of the rafters and lookouts, leaving a ventilation gap that was covered with screening.

The new roof was covered with tar paper and rolled roof shingles. At the joint between the old and new roof, the original roof shingles were laid back when the rafters, sheathing, and new shingles were added, then rebedded in a wide strip of roofing cement.

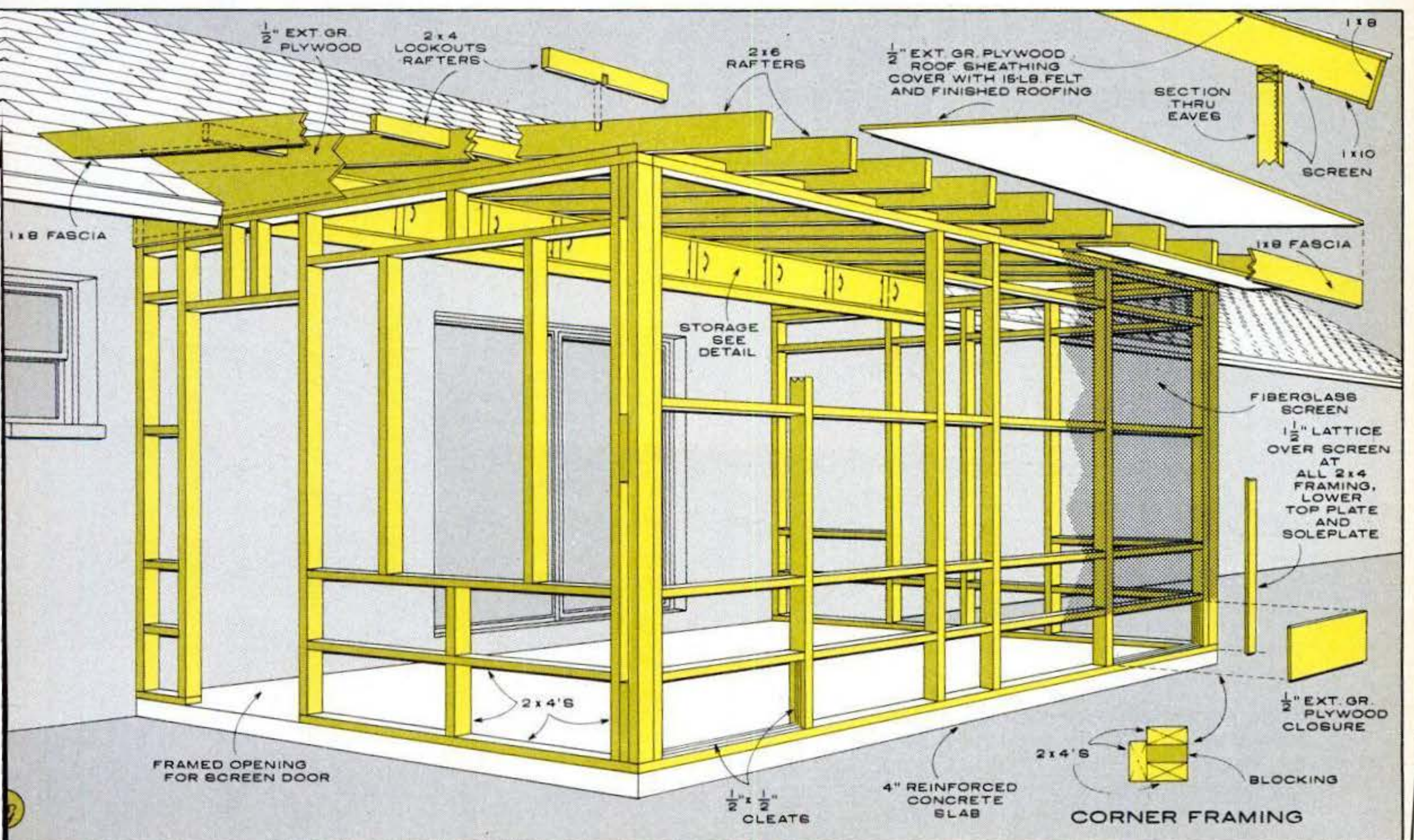
After being painted, the 2×4 walls had rolled plastic screen stapled over the outside. The excess was trimmed off, and a 1½-in.-wide lattice molding

strip was tacked to the 2×4's over the screening. The 2×4 corners were faced with 1×4's. I hung a standard screen door, brushed a color stain on the ceiling, and covered the slab with indoor/outdoor carpet.

The porch has proved comfortable, easy to maintain, and quite strong: It withstood Hurricane David in 1979. However, if you use this model in snow country, it will probably be necessary to use 2×8 rafters and heavier sheathing, either ⅝- or ¾-inch plywood. **PS**



Horizontal members of the porch wall may be spaced as you like. Author Gailor fixed his at 17 inches up from the floor (in case he wants to add a built-in bench later) and at 30 inches (handy for a built-in table). The third horizontal can be located anywhere above. Gailor also added a simple frame and doors in the area between the new and old roofs (details above) for storage.





You'll do a better, faster job with these special tools for **DIY auto maintenance**

Made-for-the-job tools will help you do pro work the pro way

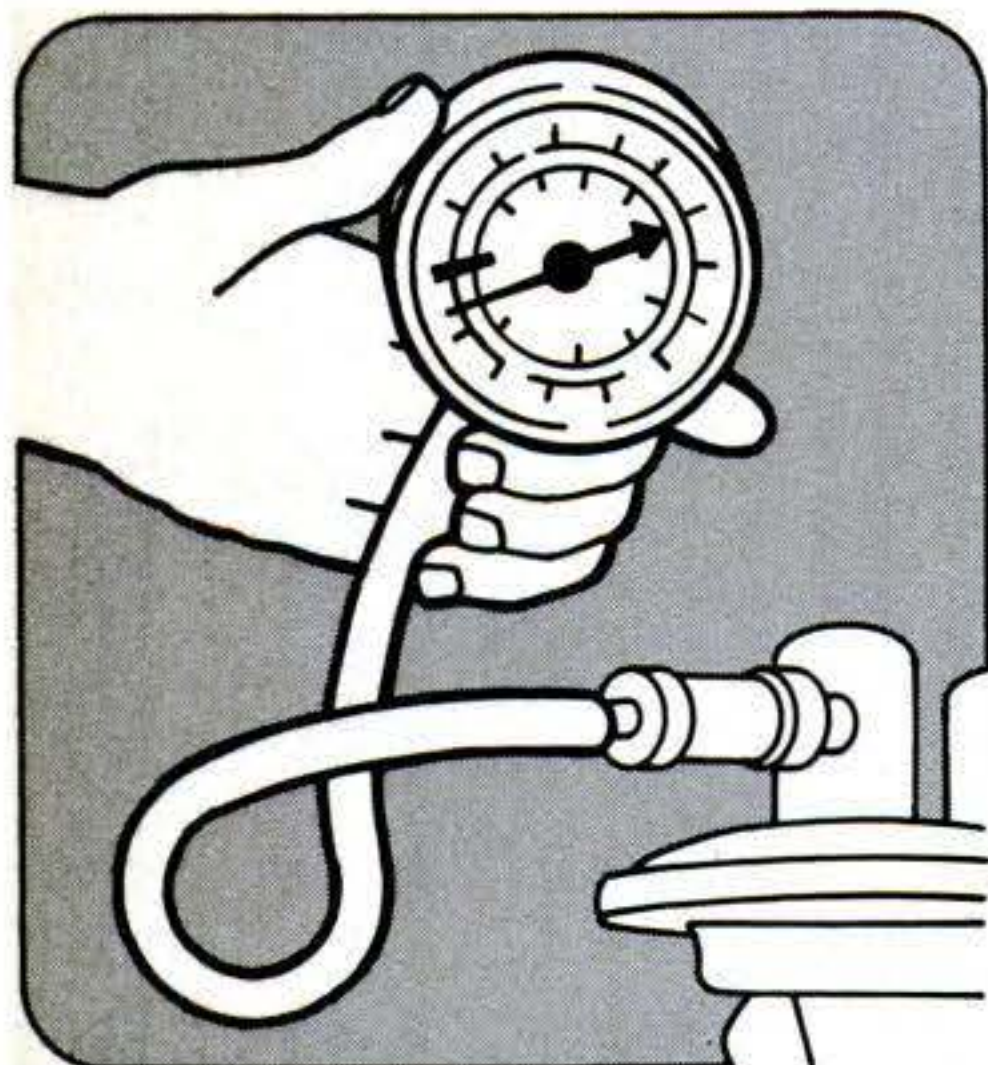
By **RAY HILL**

DRAWINGS BY RUSSELL VON SAUERS

Are you really serious about doing your own auto maintenance? If so, you probably already have a good collection of basic hand tools and a fair number of more sophisticated items such as a dwell-tach, maybe even an oscilloscope.

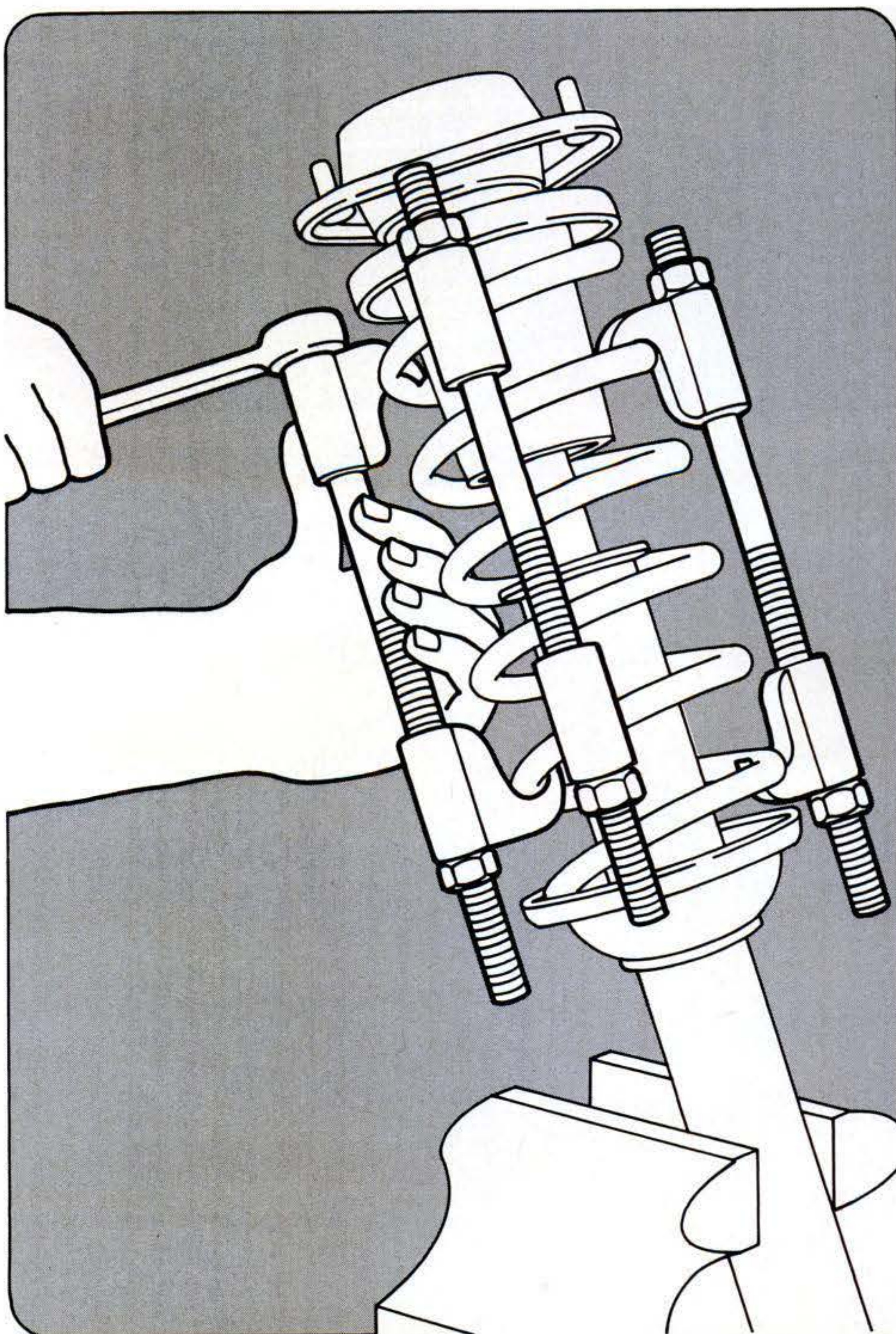
But there are many specialized tools you probably don't have. They

Continued



Vacuum/pressure tester can be used for checking vacuum (here it's checking fuel-pump vacuum) or for checking pressure. A fuel pump in good condition should draw 10 inches of vacuum and produce at least three psi at its outlet.

Strut-spring compressor must be used when replacing a bad MacPherson-strut cartridge. You should never attempt to remove a cartridge without first compressing the spring. Compress it just enough to remove the piston-rod nut.



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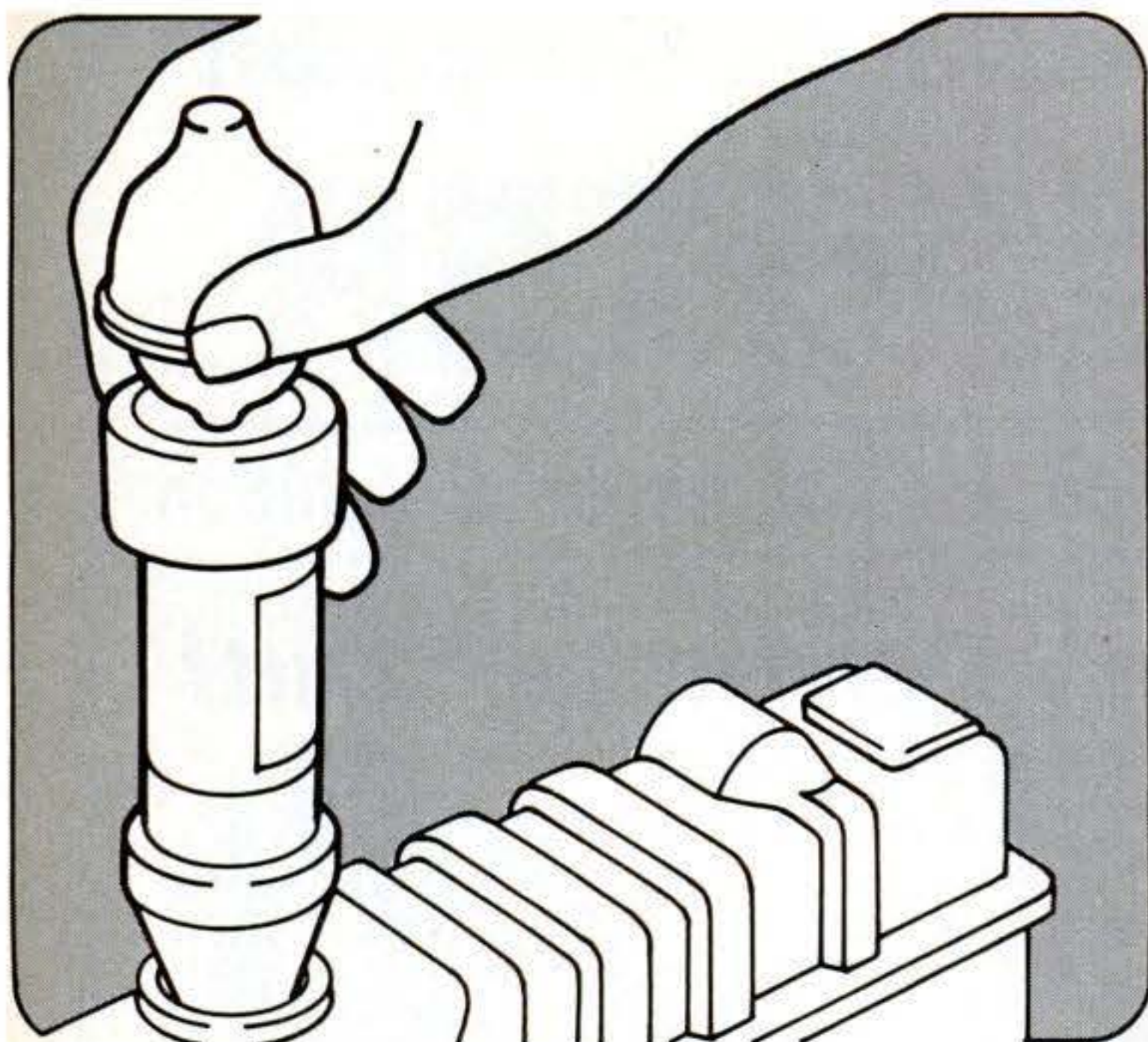
Gentlemen: Enclosed please find my check or money order for \$12.95 plus \$1.50 p&h. N.Y. residents add sales tax. Please rush my Car Computer which I must be completely satisfied with for the next 5 years or I can return it for immediate refund of my purchase price.

Name _____ Address _____

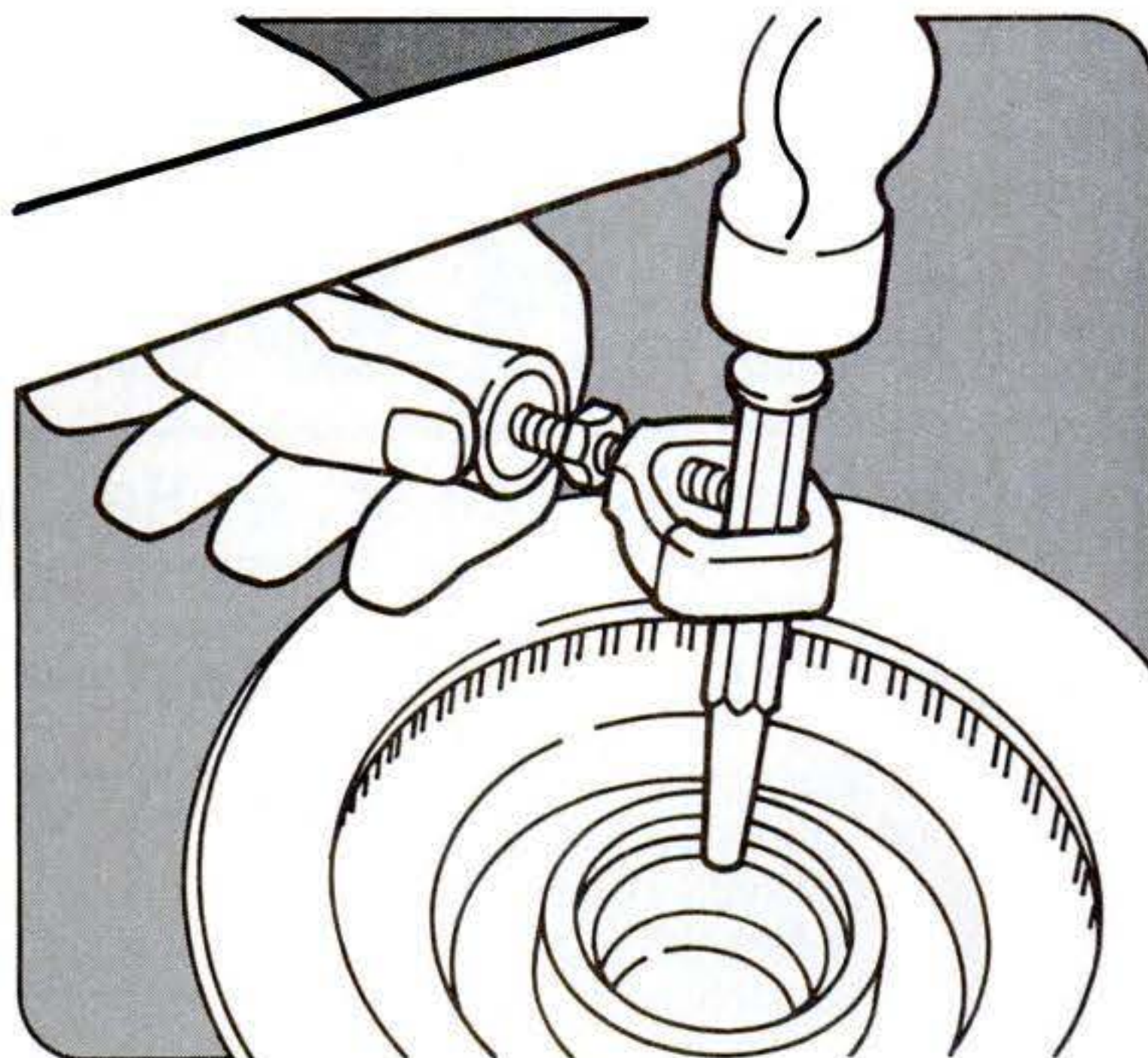
City _____ State _____ Zip _____
(Code #875)

Special tools

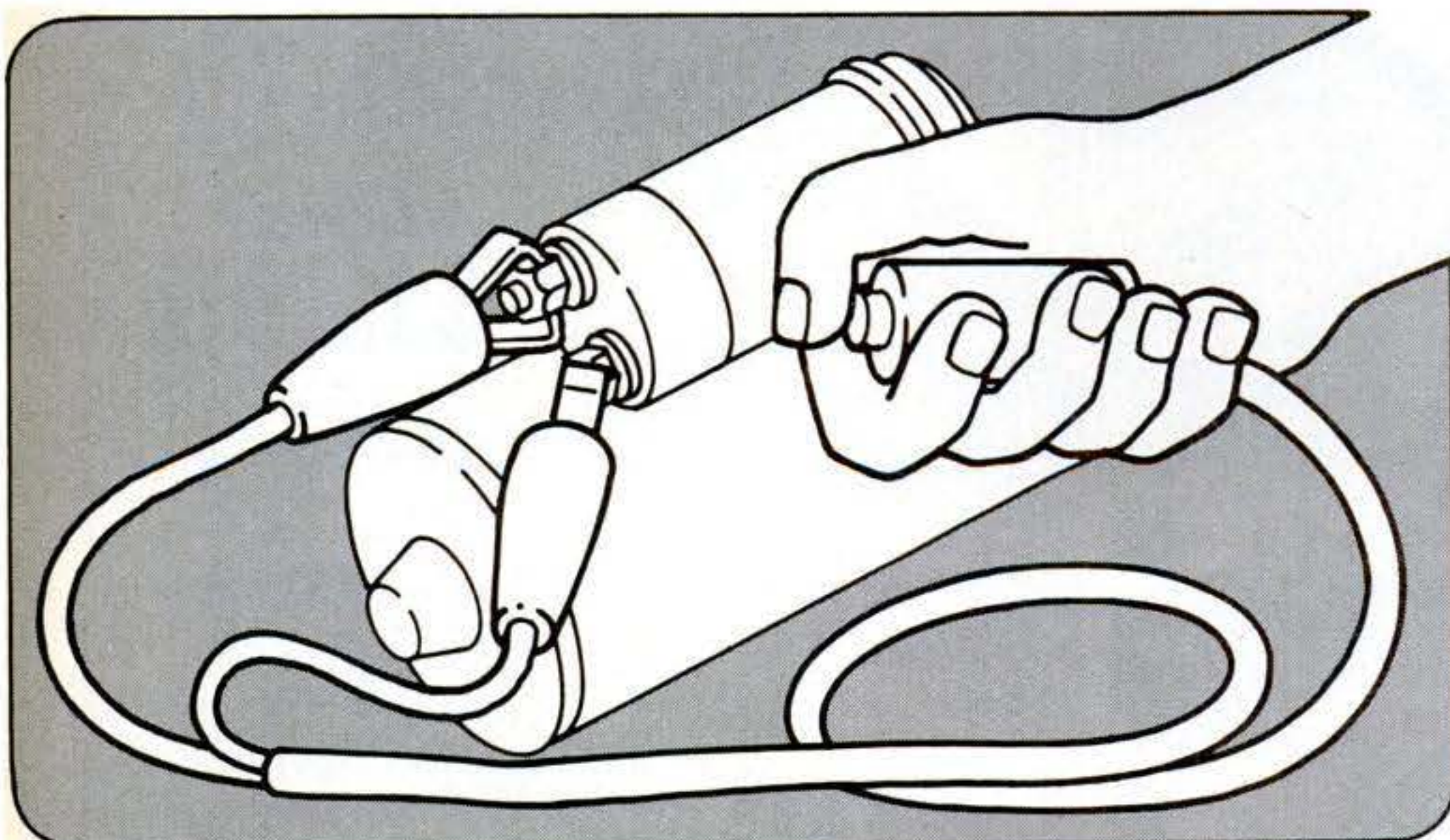
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Combustion-leak tester lets you test for a combustion leak into the cooling system. It fits in radiator neck; dye inside changes color to indicate a leak. Such a leak must be eliminated.

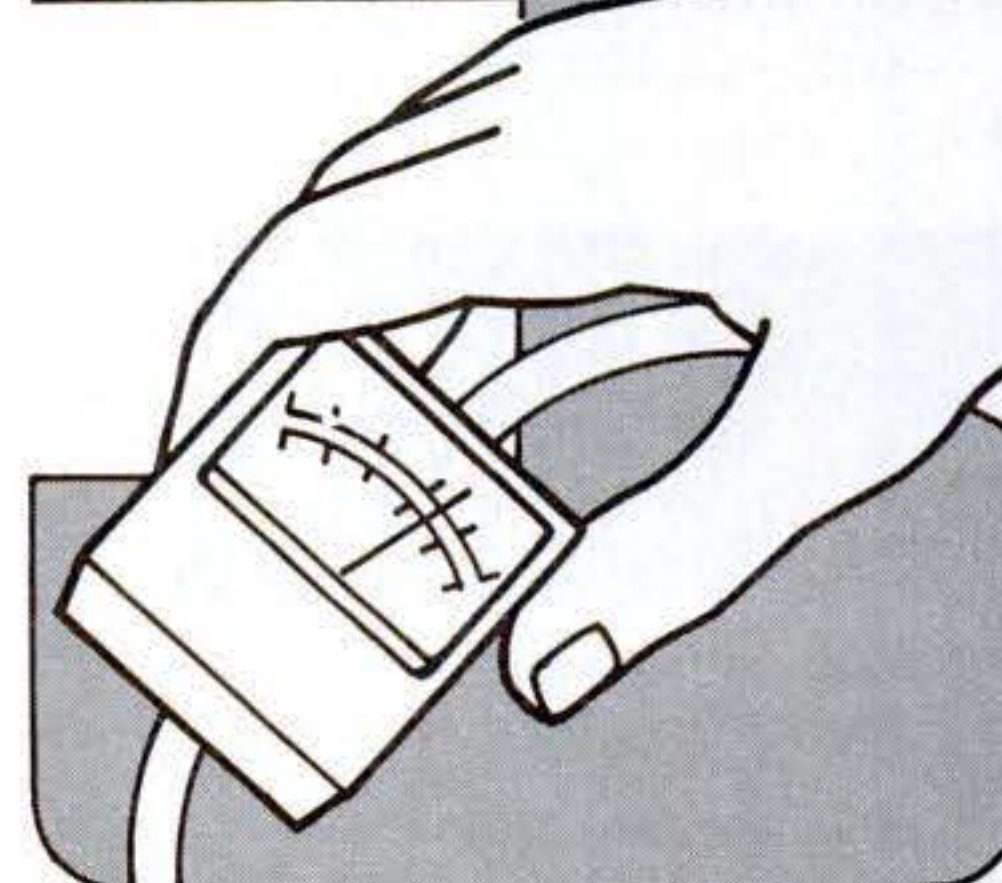
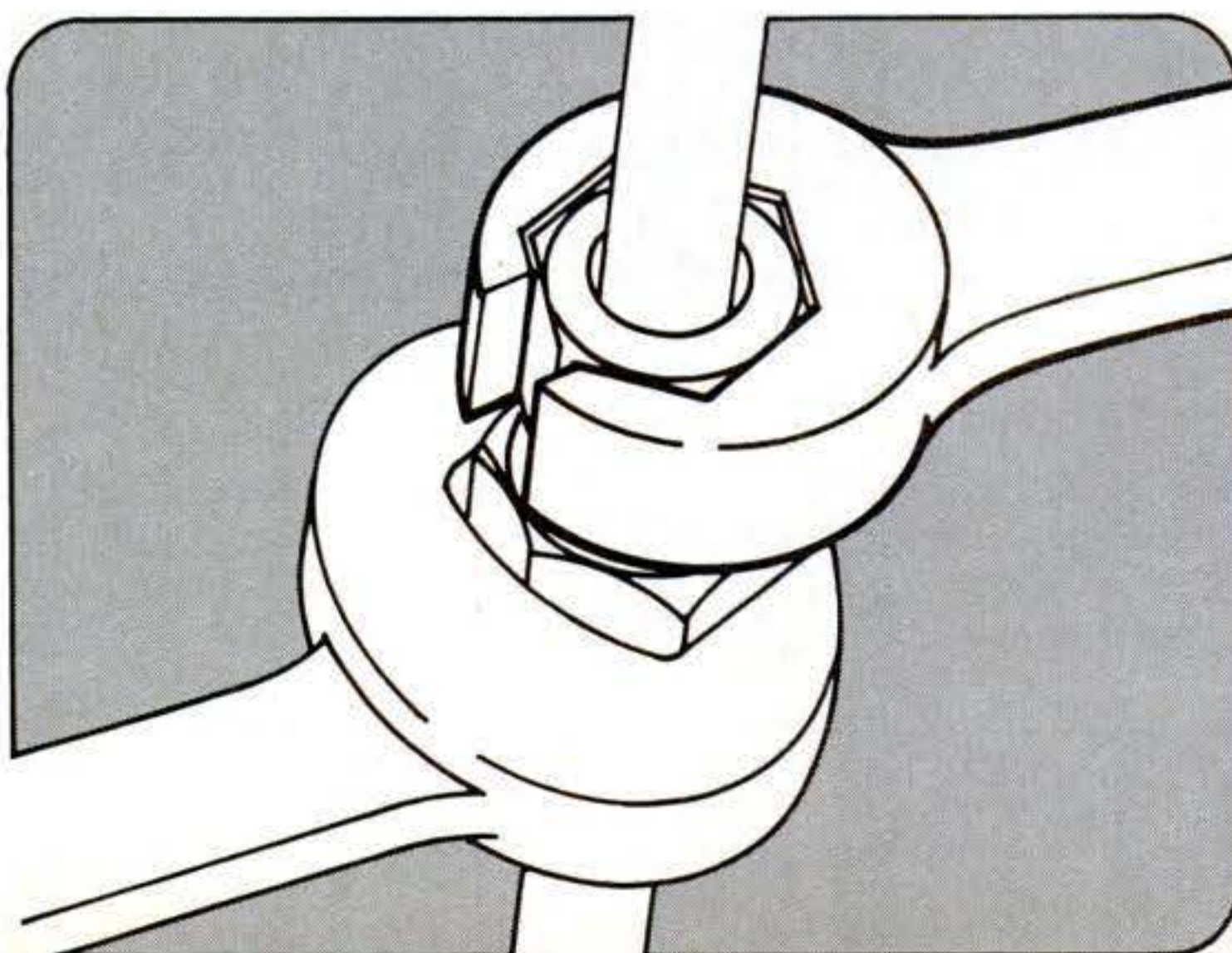


Brass drift is necessary for installing a wheel-bearing race. To decrease the chances of hitting your hand, hold the drift with a holding tool. Wear safety glasses when using these tools.



Remote starter is useful for cranking the engine when an assistant isn't available. The ignition is disabled, so the car won't start (coil high-tension lead is grounded or, on some GM HEI cars, the BAT wire is disconnected at the distributor). Leave the ignition switch on when cranking to prevent any ignition-system damage.

Line wrench should be used anytime a flare nut is loosened or tightened—as on brake and fuel lines. The wrench grips nuts securely and lessens chances of rounding the flats.



Ammeter is needed for checking starter current draw and for checking alternator output. Shunt type (top) connects in series with circuit being checked. Inductive type (bottom) is held against cable or wire. A third type, not shown, has an inductive clamp that encircles the wire.

Continued

STOP BURGLARS BEFORE they enter your home

Protect your Home and Business with this new micro-computer burglar alarm "FREE" for 30 days.

Burglars seek easy targets. Few have the daring or the knowledge to challenge the new Perim-A-Tron™ Home Security System. No other burglar alarm under \$2,000 can give you more protection...or match it for features that will give you and your family safety and peace of mind. For starters, it is wireless, installs in minutes, and is portable should you ever move.



Perim-A-Tron's™ 20 button keyboard gives you protection a \$2,000 commercially installed system can't beat. Includes powerful remote horn.

10 minutes and scaring away the intruder, the system shuts off automatically and re-sets itself.

A CONSTANT GUARDIAN

Leave Perim-A-Tron™ in Test Mode during the day and it will signal when anyone leaves or enters. This thoughtful signal will not operate the remote horn but gives a 2½ second warning on the internal speaker only.

If power fails (or is cut-off), the console has a battery back-up. And each battery powered transmitter/sensor will signal at the console if the battery runs low.

The Perim-A-Tron™ system is **highly resistant to false alarms because it is not sensitive to motion or sound.** Pets can roam at will, curtains can blow in a breeze, you or your children can visit the kitchen for a midnight snack—all without setting off an alarm.

COMING HOME SAFELY

There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's **EXTRA PROTECTION DESIGN** lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

COMPARE IT

Hard-wired "commercial" burglar alarms can cost \$2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to \$200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines **pre-entry** protection with micro-electronic circuitry to provide the most protection at the lowest cost.

U.L. LISTED

The Perim-A-Tron™ Home Security System is listed by Underwriters Laboratories as a **burglary protection device**, a rating which goes beyond electrical safety. To earn this listing our alarm was thoroughly tested for critical burglary protection functions such as transmitter range, sound volume, battery back-up, keyboard component life, battery failure warning, and test function. This tough-to-get U.L. listing resulted from the exacting standards engineered into the Perim-A-Tron™.

YOU BE THE JUDGE

We urge you to order just the basic Perim-A-Tron™ system (pictured above) for a 30-day trial period. Use it to protect your family while you sleep and to protect your home while you're away. Then if you're not convinced that the Perim-A-Tron™ is the most advanced, efficient security system available today, return it undamaged for a complete, no-quibble refund—including return postage. You are protected by a 90 day manufacturer's warranty as well as Shelburne's 25 year reputation for satisfied customers.

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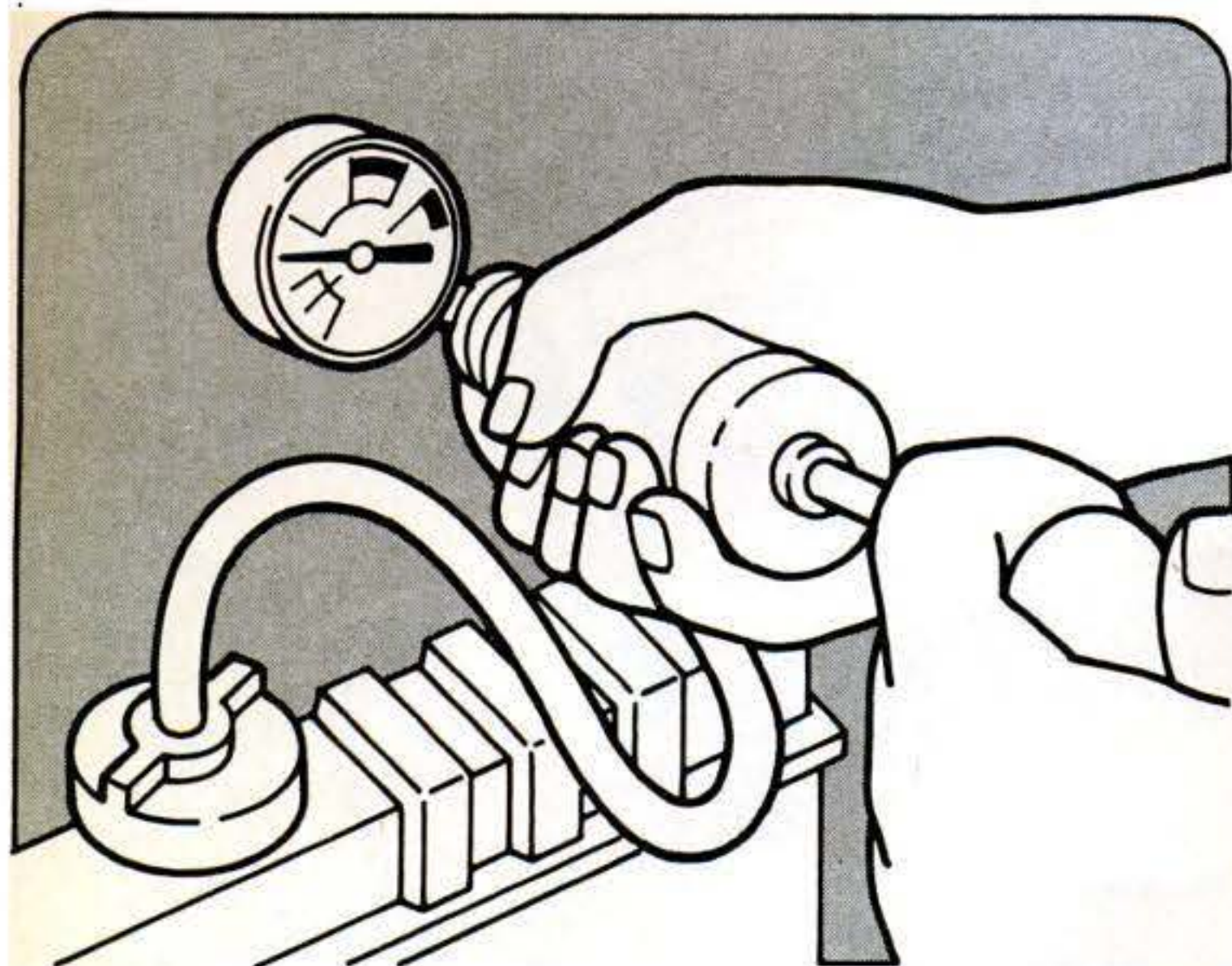
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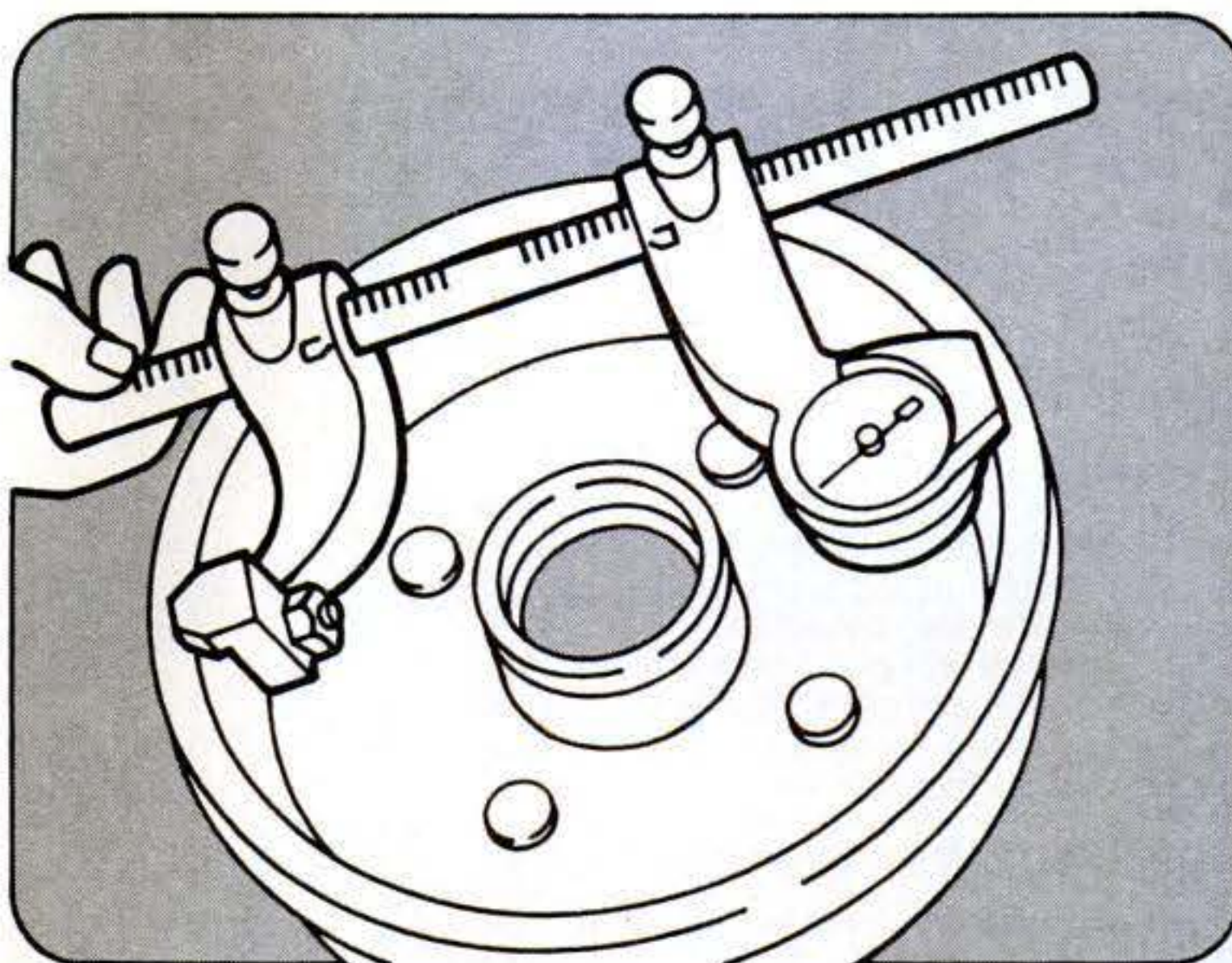
This photo shows a transmitter & magnet installed. If a break-in attempt occurs, the transmitter and magnet become separated triggering a wireless radio signal which activates the alarm. Installation takes only a few minutes and doesn't even require a screwdriver.

Special tools

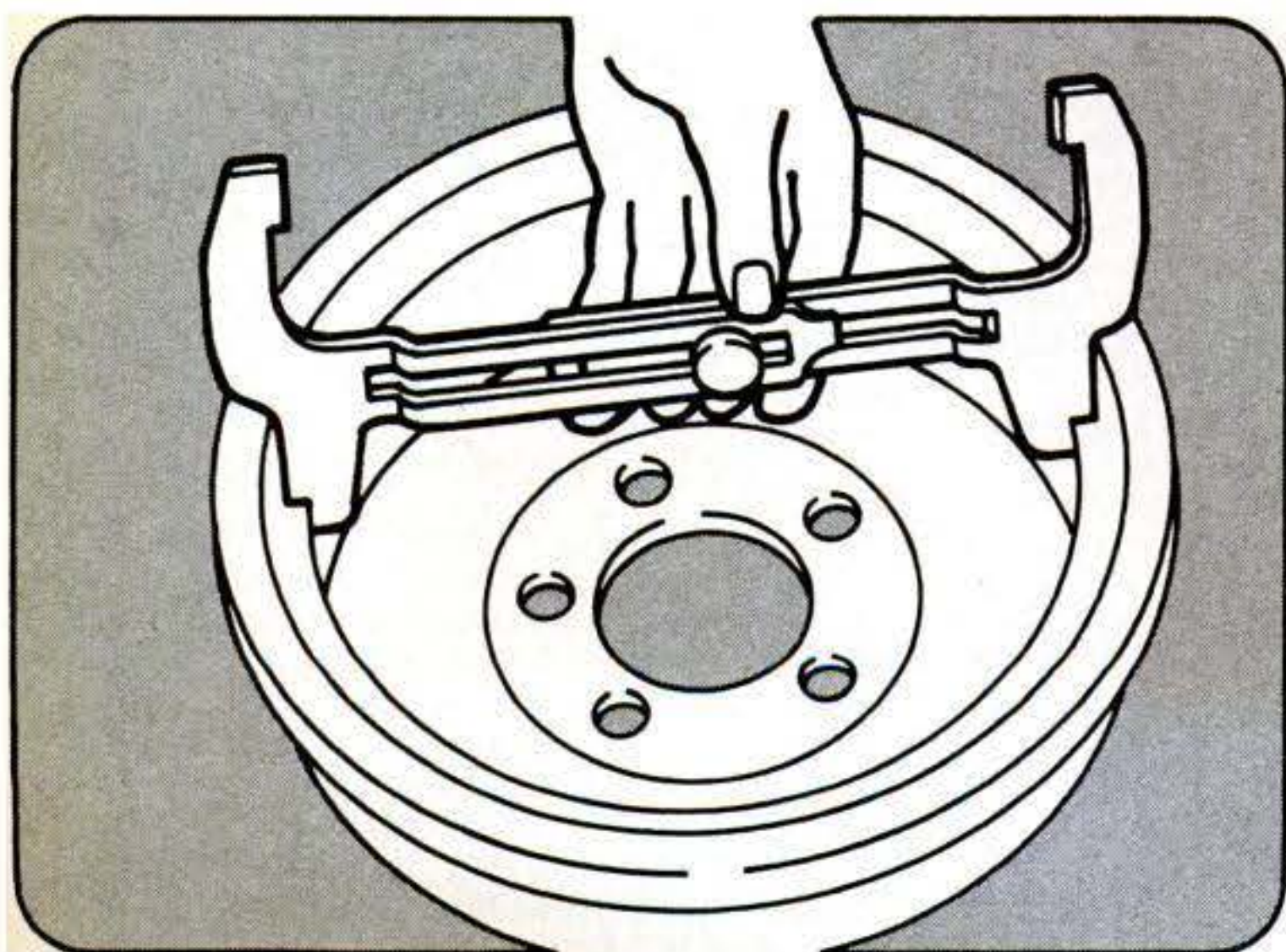
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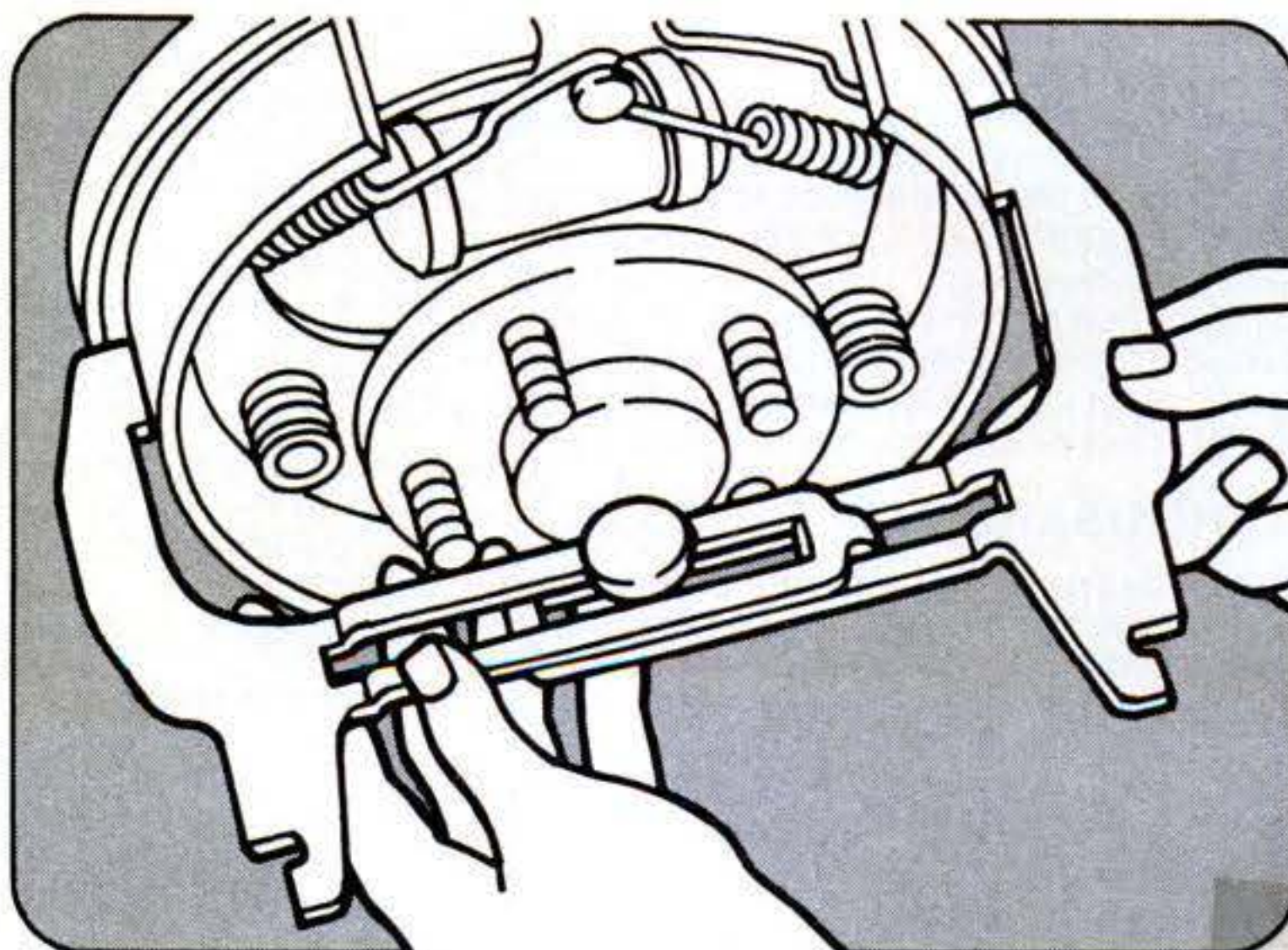
Cooling-system pressure tester can pressurize the cooling system to test for leaks (above) by attaching to the radiator neck and pumping air into the system. It can also check pressure caps.



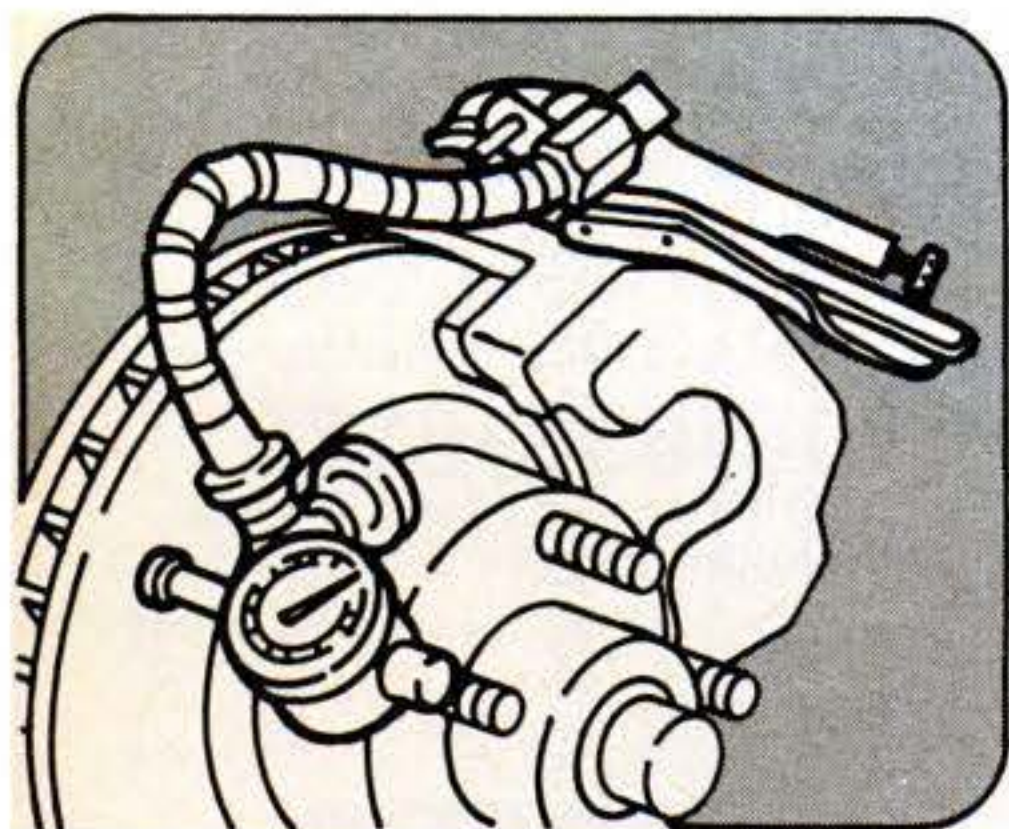
Brake-drum gauge measures drum, which should be turned when brakes are rebuilt. If too much material is gone, drum must be replaced. Specs appear in the shop manual or on the drum itself.



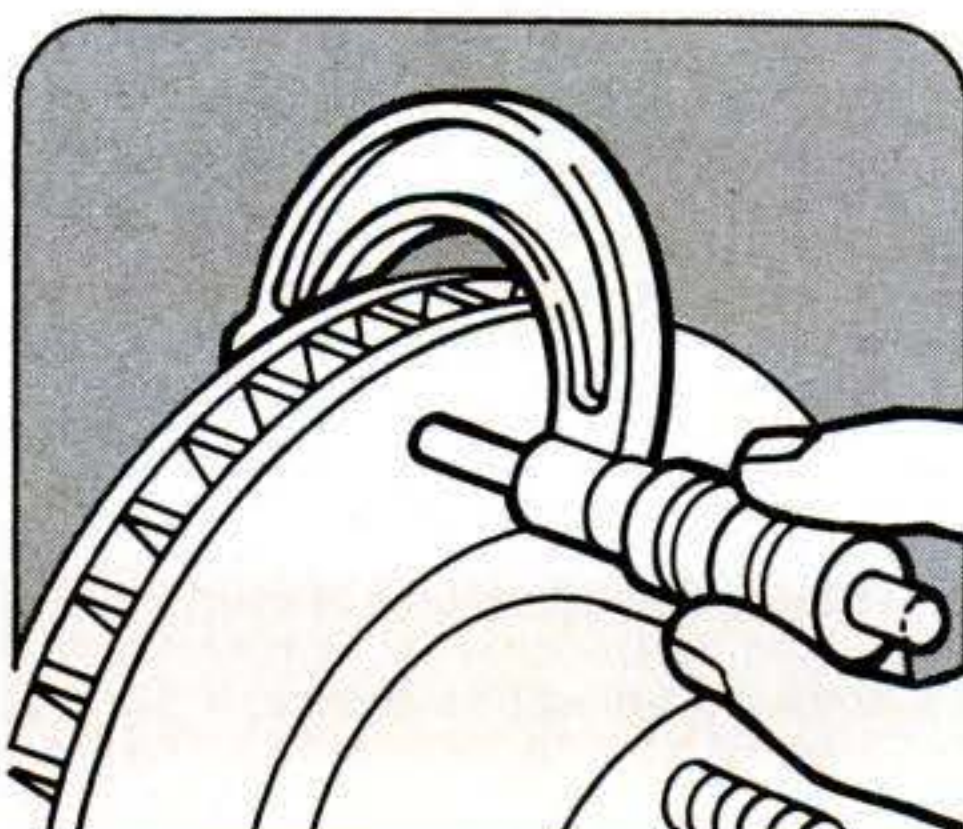
Drum-brake adjusting tool makes adjusting rebuilt brakes easy. The tool's narrow jaws are adjusted to the drum's inside diameter (above). Then the tool is flipped over, and brakes are adjusted so that the tool's wide jaws will just barely pass along the brake shoes' widest part (above right). Another tool that can be



used for the job is a brake-adjusting tool (not shown). The tool is inserted into the slot in the brake backing plate or the slot in the brake drum, and the adjuster is turned until the brakes barely drag when the wheel or brake drum is turned. It's important that brakes be adjusted properly after they are rebuilt.



Dial indicator with universal mount is useful for many precision measuring tasks. Here it is being used to check radial runout on a disc-brake rotor. A few other uses: checking valve lift, crankshaft end play, valve-guide wear, tire runout.



Outside micrometer is another handy precision measuring instrument. Here, brake-rotor thickness is being checked with it. As with a brake drum, a brake rotor cannot be turned on a brake lathe if the rotor doesn't meet thickness specs.

can make a number of jobs easier to do. Indeed, without them, many jobs can't be done at all. Some of the most interesting of those tools are shown here. They'll put a lot of pro skills within your reach.

The tools can be purchased at such places as auto-parts stores and jobbers that sell to auto mechanics (many sell to the public, too). Sears, JCPenney, and Montgomery Ward also carry prototype tools.

One special aid is a must—a service manual for your car. It provides specs and trouble-shooting and disassembly/reassembly information. Your owner's manual should tell you how to order one. Consult the manual before starting any unfamiliar job. **E3**

Innovations

The sharpest picture ever achieved in big-screen projection TV

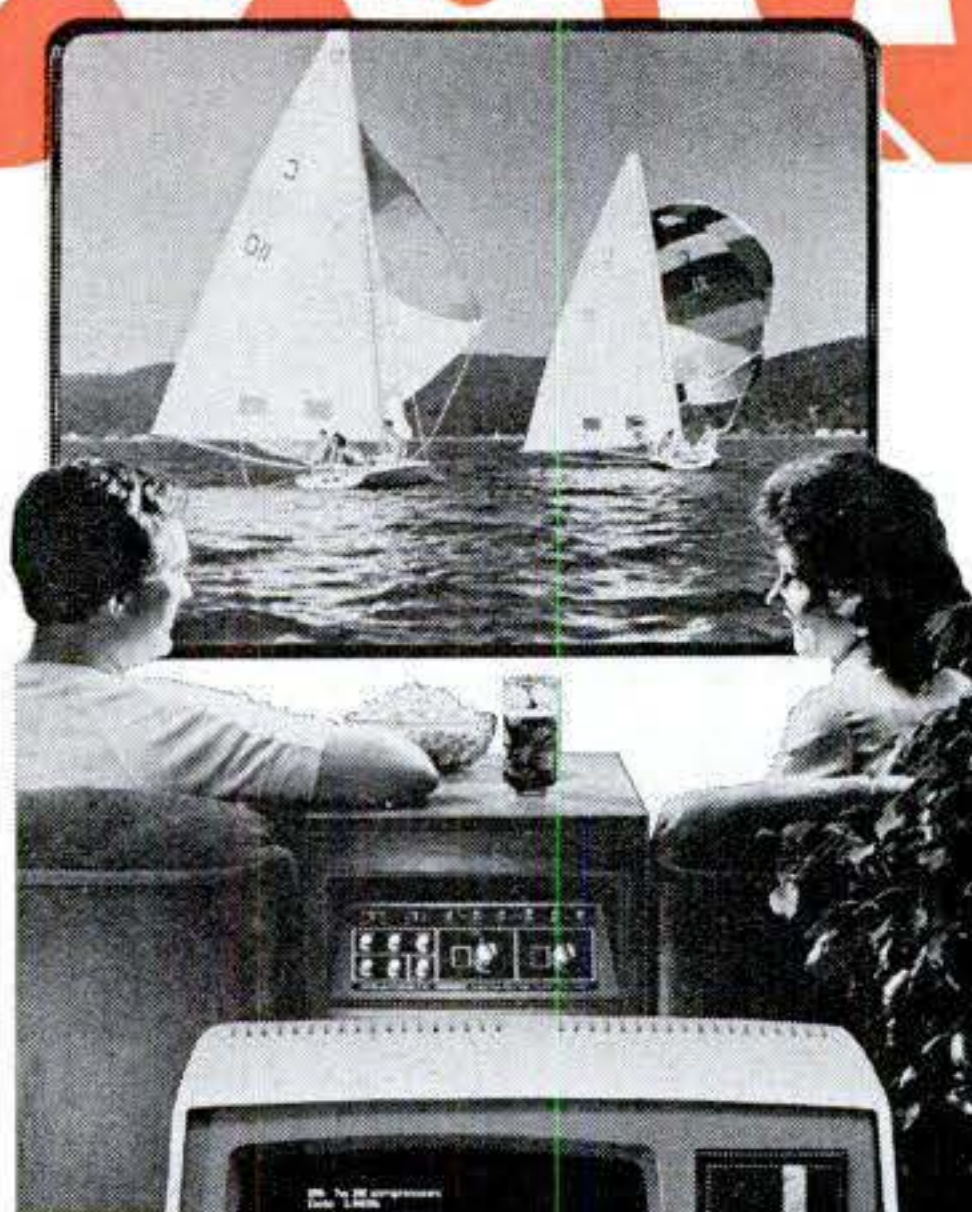
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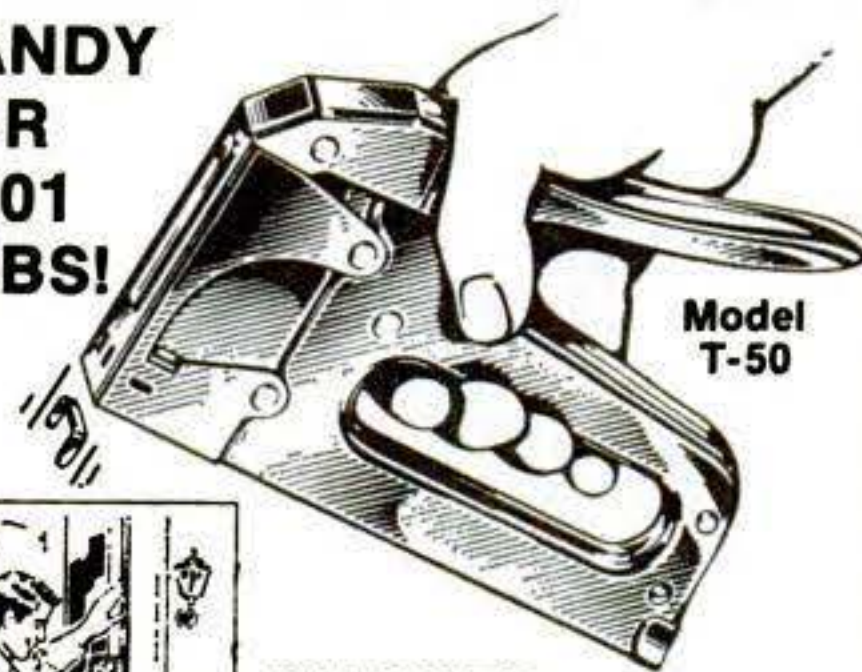
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SHOP TALK

By PAUL BOLON



New line of shop tools

My introduction to Vega shop tools occurred a short while ago at a show in Atlanta. The person who acquainted me with the finer points of the machinery was none less than their creator, Gordon Snoeyenbos, a man of resolute good cheer. Before he designed the Vega tools, Snoeyenbos explained, he was a consulting engineer for industrial machinery and materials. As an avid woodworker in his spare time he found his enthusiasm for his hobby dimmed only by the awkwardness of some of his shop tools. Obviously, if you can't buy what you want you must make it yourself; ergo, Vega tools.

I gave the 10-inch table saw a close going over. The rip fence really did align parallel to the blade. It's secured with a single cam-action lever and lifts completely off the table and drops on again anywhere along the square guide bar. In addition, a thin pusher with a handle grip (it slides in a slot in the top of the fence) is

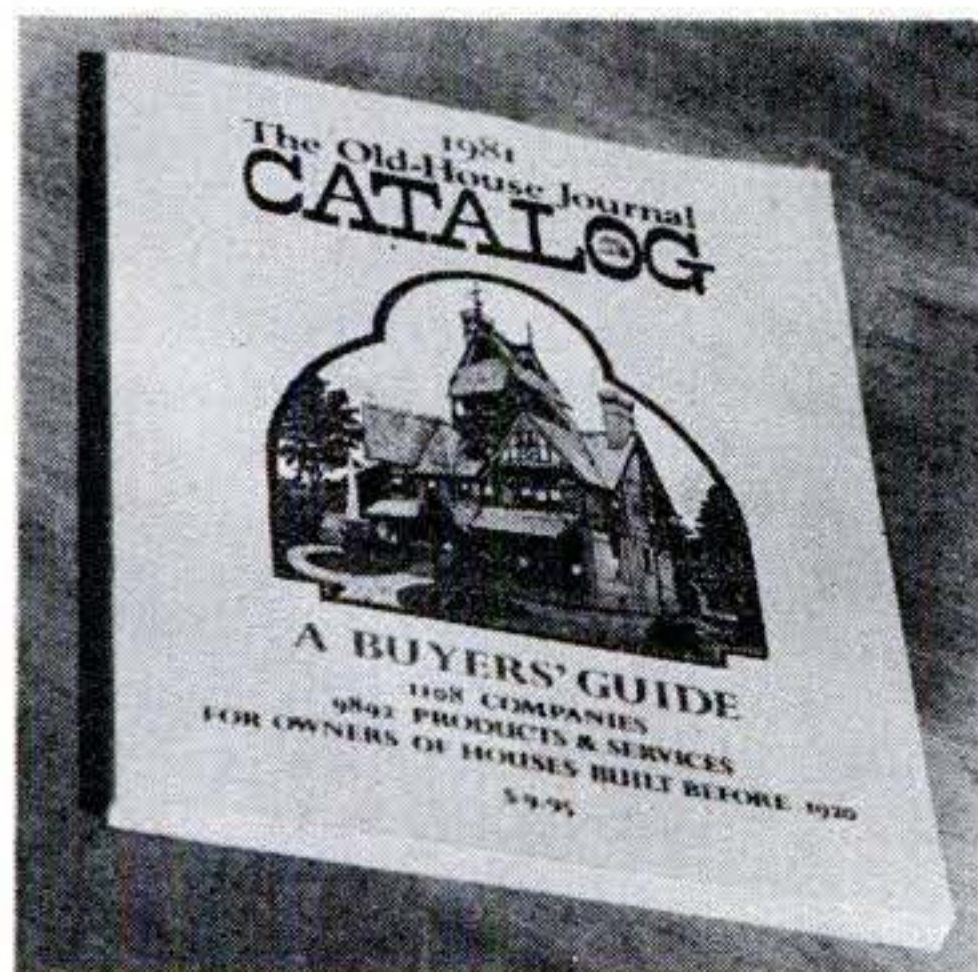
used to move narrow stock past the blade, eliminating the need for push sticks. The front guide bar has a measuring tape embedded in it for quick, accurate set-ups.

Other features of the saw include a spring-counterbalanced motor for easy raising and lowering, built-in racks on the body for the miter gauge and rip fence, a floating steel-mesh blade guard, twin-belt drive, relay stop and start, and an impressive two-hp motor that is completely sealed and fan-cooled—industrial quality. The saw has all these innovations and more, which make for accuracy, large capacity, durability, safety, and quick adjustments. In short, it's a joy to use. It's not a tool for the one-hour-a-month user. The price of the complete package totals about \$1,800.

The other tools in the Vega line—a lathe, a band saw, two sanding machines, six- and eight-in. jointers, and a scroll saw—offer the same solid design and concern for convenient use. For more information

on these top-quality tools write to Vega Enterprises, R.R. 3, Box 300B, Decatur, Ill. 62526.

Hard-to-find oldies



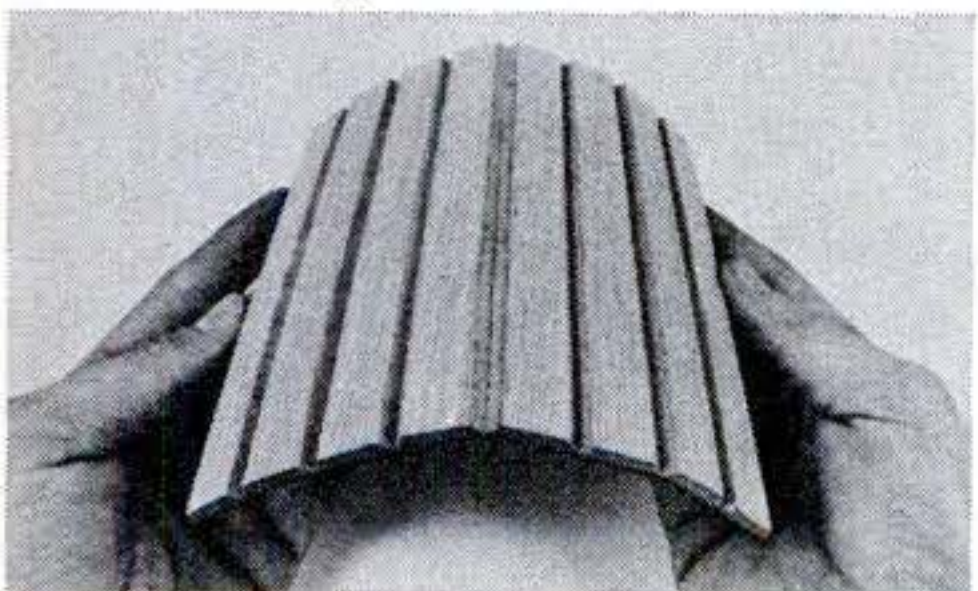
"They don't make that anymore." I've heard the deadly refrain many times from sales clerks—have even come to expect it. Roughly translated, it can mean either "We don't carry that item anymore," or "What's that? I've never seen or heard of such a thing."

Nevertheless, it—whether it be odd-looking bathroom fittings, Victorian millwork, or stenciling supplies—is probably still made. And a catalog of such difficult-to-find hardware for pre-1920 houses, *The Old-House Journal Catalog*, is sold to help you track them down.

The catalog lists material and hardware necessary for restoring and decorating older houses—or new ones if you wish—as well as the companies that sell the products. You can find porch columns, weather vanes, chair rails, dumbwaiters, gas-light fixtures, canvas for walls—even where to have your porcelain refinished.

The catalog costs \$9.95 plus \$1 for handling from The Old-House Journal (69A Seventh Ave., Brooklyn, N.Y. 11217).

Tambour by the foot



Tambour, the familiar slatted cover for American roll-top desks, is usually made by a painstaking process requiring precise machining and gluing onto canvas backing ["Roll-top Cabinets," PS, March '78]. Now you can buy ready-made tambour in oak or birch veneers—you only have to make your own cabinet tracks.

The tambour, which can also "roll up" horizontally, is made from 1/2-inch-wide slats with a pre-cut bevel, so you can use the material on inside curves without binding. It's sold by The Woodworker's Store, 21801 Industrial Blvd., Rogers, Minn. 55374. Catalog: \$1.

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Haul-it-yourself concrete

[Continued from page 75]

ably get the vital water content pretty close by appearance alone. But to buy concrete made this way can be hazardous. At any rate, my batcher missed the mark a mile: The concrete was downright sloppy.

The segregation process began as soon as the mixer arms had stopped. Then, as the old-style mixer hydraulically lifted over the hopper trailer, the attendant sprayed even more water into the mix as it poured out (see photo). I have no idea why. The additional water floated to the top. I gave this batch to a farmer friend for landfill.

Typical prices for hopper concrete seem acceptable compared with having so small a batch of ready-mix delivered: one cubic yard, \$49; 3/4 yard, \$46; 1/2 yard, \$43; 1/4 yard, \$40. U-Cart dealers set their own prices. My dealer's prices were lower, and he furnished the trailers free with no time limit. But no refund was offered for my unusable load.

The next day I tried a mixer-trailer HIY dealer. He used weigh-batching equipment, and water was measured by a gallon meter. The dealer knew about trial mixes, compressive-strength tests, and air entrainment. His trailers were one-cubic-yard miniatures of ready-mix truck units. He asked me what maximum-size aggregate I wished. That's important. Max-ag size should be one-fourth the thickness of your project. A 3/4-inch maximum is right for most uses around the house.

Cost of the trailer-mixed concrete: one cubic yard, \$44.19; 1/2 yard, \$29.47—quite reasonable. The firm would not sell less than one-half yard, and prices included 1 1/2 hours of mixer-trailer time. Additional trailer time was \$6 an hour. Although the mixer trailer proved much heavier than a hopper trailer, the project went well. I hauled the mix some 30 miles and cast my small footing. I paid \$15 in overtime charges.

Hitching up

A fully loaded mixer trailer weighs 6,200 pounds. A loaded hopper trailer weighs 4,680 pounds. The concrete alone weighs almost 3,800 pounds per cubic yard in the plastic state. Any trailer heavier than 3,500 pounds is supposed to be towed with an SAE Class 3 load-equalizing hitch with a 2 3/8-inch ball. Yet the trailers I saw are set up for two-inch hitch balls common with Class 2 hitches. (U-Cart's newer hopper trailers feature load-equaliz-

Continued

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HOW TO DRILL A BACKYARD WATER WELL

BILL HARRINGTON

I've been drilling water wells in Oklahoma for about 15 years.

When I first saw the ad that claims a man can drill his own water well with a Hydra-Drill, I was extremely skeptical. I thought to myself — how can that be? That's impossible. It takes a big engine, it takes a big rig to drill a water well. But my curiosity kept nagging me, so I sent off for the information.

My daughter's boyfriend is a well driller over in Arizona. I showed him the Hydra-Drill literature. His first reaction was "I don't believe it. I don't believe a 3 hp. drill can do the same thing my 100 hp. drill does." But the more I studied it, the more it sounded like a good idea.

A WATER SHORTAGE

Another thing on my mind was the drought. We're having the worst drought here since the dustbowl days back in the '30s. A lot of towns around here all the way over to Tulsa are running short of water, and some of them have started water rationing. It's very hard on a lot of people, but business is good for well drillers. I'd been thinking about buying another drill and putting my son Robert in business. He's 18 years old, and he'd never worked on a drill before. I decided he could learn with a Hydra-Drill.

EASY SET UP

Now when I started out in the drilling business 15 years ago, I had a big drill that just about worked me to death. Later, I got a rotary drill. It was easier to operate, but it took a day and a half to set up and drill a well in this area. You can't imagine how I felt when they delivered our Hydra-Drill. It was so compact, very simple. Robert and a young friend of his took it out and set it up in just a few minutes.

OUR FIRST HYDRA-DRILL WELL

The day we went out to drill our first well with the Hydra-Drill, I was all fixed to work with the boys and give them plenty of advice. However, it was a very hot day — about 100 degrees — and once they got started drilling I could see they didn't need me standing right there, so I went over and sat down in the shade of a tree. In about an hour, they came over and I asked them if they were taking a break, and they said no, they had just finished drilling the well.

It was amazing. They had drilled down forty-seven and a half feet and hit a layer of beautiful, coarse sand — the kind that produces good water and a lot of it. They had drilled that well in less time than it takes me just to set up my big drill.



PHOTO BY TONY JACOBY

Later, I figured they had drilled that well with less than one gallon of gas. My big drill would burn up at least fifteen gallons of gas for that job!

MAKES MONEY

The next day we drilled a well 115 feet deep through rock, and it went fast too. The Hydra-Drill really takes the hard work out of it. It's fast and economical, and that's what it takes to make money drilling wells.

Also the Hydra-Drill is so portable we can set up and drill anywhere. In the past, I've lost out on some jobs because people were afraid my big drill would tear up their yard. With the Hydra-Drill, we can drill without tearing up anything or making a mess. This is a big selling point to my customers.

I'm just grateful to have this Hydra-Drill. I've got my son started in a good business he can make some money with. If I had bought another big drill, it would cost thousands of dollars, and that is just ridiculous because the Hydra-Drill does the job just as good. In fact, I figure we earned enough to pay for the Hydra-Drill the first week. From here on, we're in the blue chips.

GOOD, PURE WATER

I believe anyone can drill a well with a Hydra-Drill. Even if they just wanted to drill their own well, they'd save money. It's simple and it's easy if they just read the instructions. And the best part about it is that you get good, pure water without all those chemicals in it, and the water costs you, say 5 cents for a thousand gallons. You certainly can't buy city water for that. And it's a great feeling to have all the water you want even when

the city is rationing water to everyone else.

The man who invented the Hydra-Drill really knew what he was doing. Modern technology is a wonderful thing, isn't it?

NOTE: Popular Science readers can get a big, fully illustrated information kit on the Hydra-Drill including a booklet, "How to Drill Your Own Well." The information kit is available free, without obligation. Requests should be addressed to DeepRock Mfg. Co., 5431 Anderson Road, Opelika, AL 36802.

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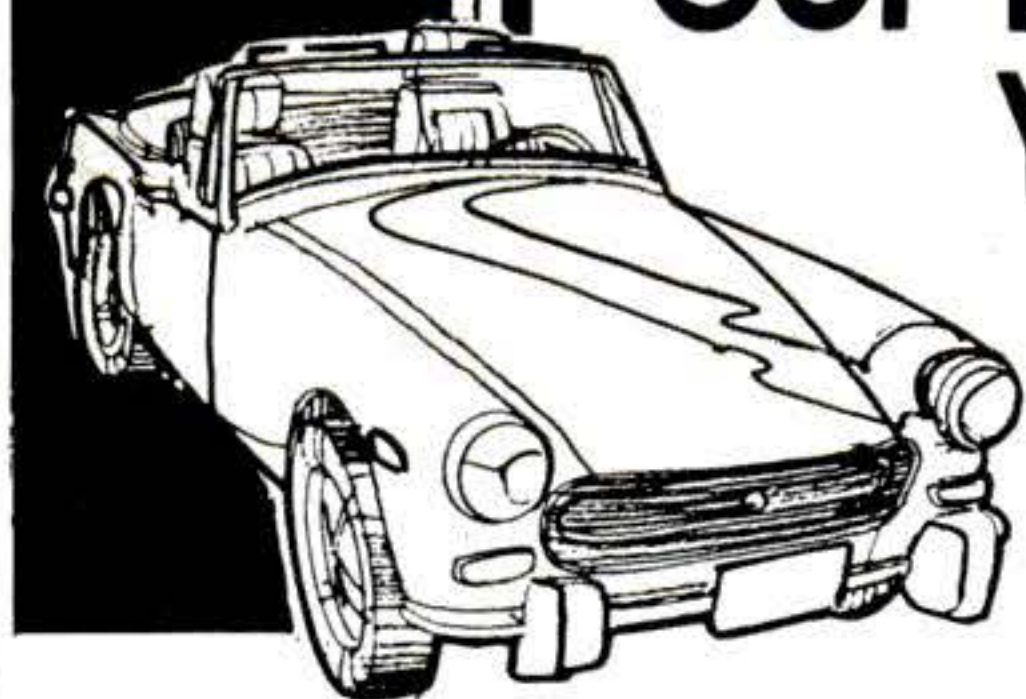
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Haul-it-yourself concrete

[Continued]

ing hitches that fit two-inch hitch balls.) With hopper trailers you can get around this by limiting them to half-yard loads, but you can't get around it using the heavier mixer trailer. In no case should you try to haul either one using a clamp-on bumper hitch or any Class 1 bumper hitch: A car's bumper is not that strong. A pickup truck's dock bumper will work, however.

A trailer can be handled beautifully by a full-size car or light truck. A mini-pickup can do it, too. According to Brooks, a full one-yard load in one of his newer load-leveling hopper trailers can be pulled behind a sub-compact car, providing it has the necessary frame hitch. (Trouble is, few do.) Be sure the trailer's stop/turn/taillights are properly connected to the towing vehicle's lighting system—and working. Too often the wiring is encrusted in concrete and not functional. Don't drive off without the safety chains hooked up, either. Some trailers have surge brakes to help you stop, a great help. Drive slowly and carefully. Start, turn, and stop gently. If you aren't a whiz at backing with a trailer, find someone who knows how. On the job isn't the time to learn.

Carry a pound of sugar with you. If you break down and cannot get a mixer trailer emptied before its concrete would set, dump in the sugar and mix: The sweets will postpone set-up. But the mix may still have to be dumped—you don't know when it will finally decide to set.

Use good judgment. Don't back over muddy ground, septic systems, or anything that your car could not safely drive over. Never let the heavy trailer go down a steep incline—you may not be able to tow it back up. And don't go too close to a deep hole in the ground, such as a dug-out basement. You may end up rolling into it.

A haul-it-yourself concrete project goes well with three workers. One takes care of getting, cleaning, and returning the hauling unit. The other two place and finish the concrete. Thus if one is detained while returning the unit, the concrete project will proceed on schedule.

Should you buy concrete from a haul-it-yourself dealer? Sure, if his equipment and knowledge of concrete meet your needs. My experience with hopped concrete may not be typical. As with all independent businesses, the quality of the product may vary. Certainly you should check out any dealer before you buy. **E**

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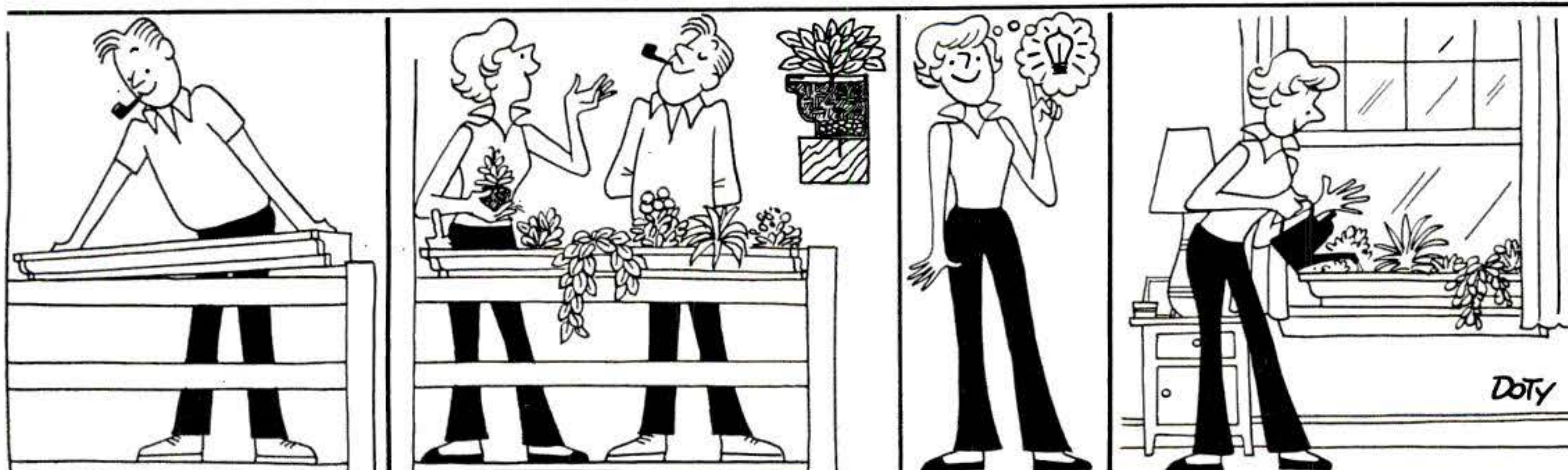
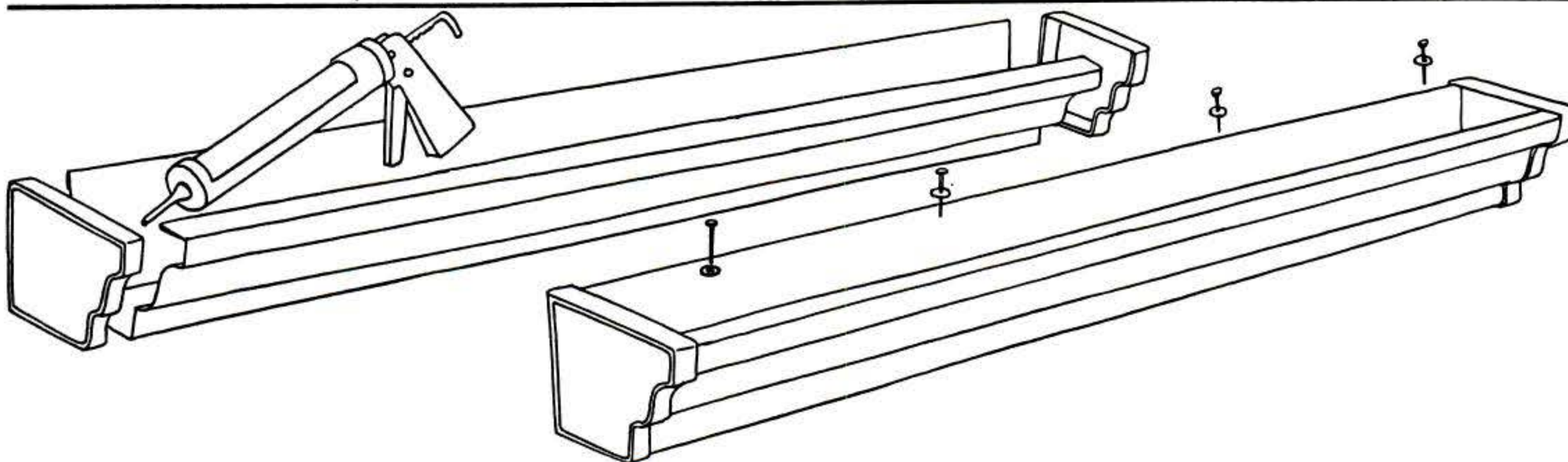
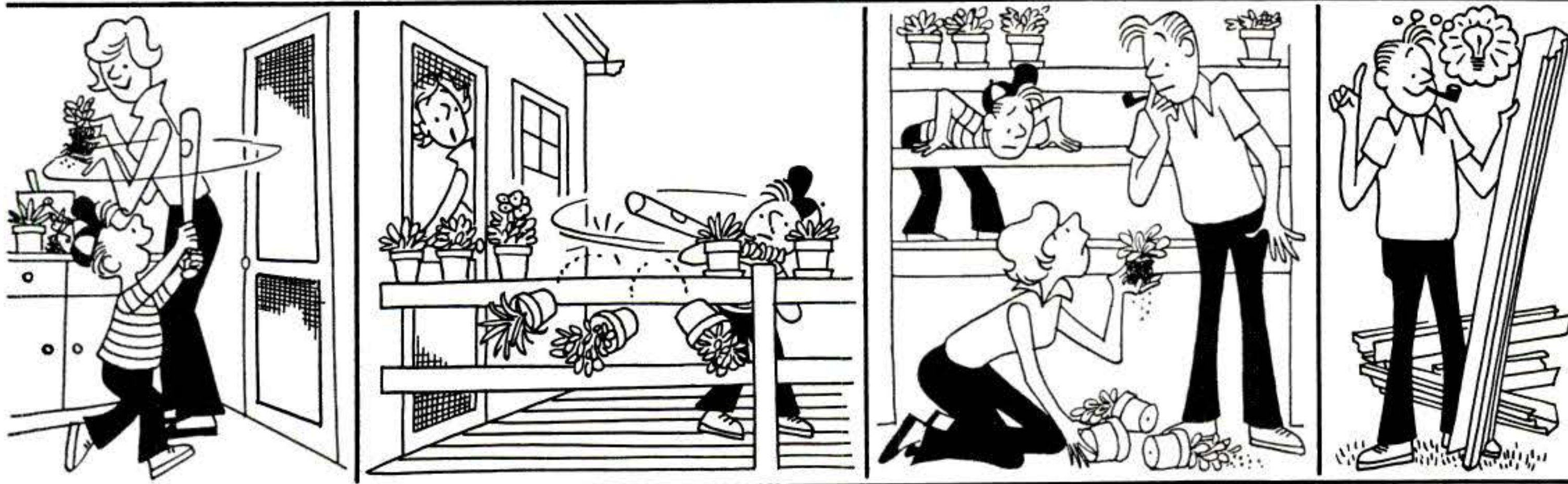
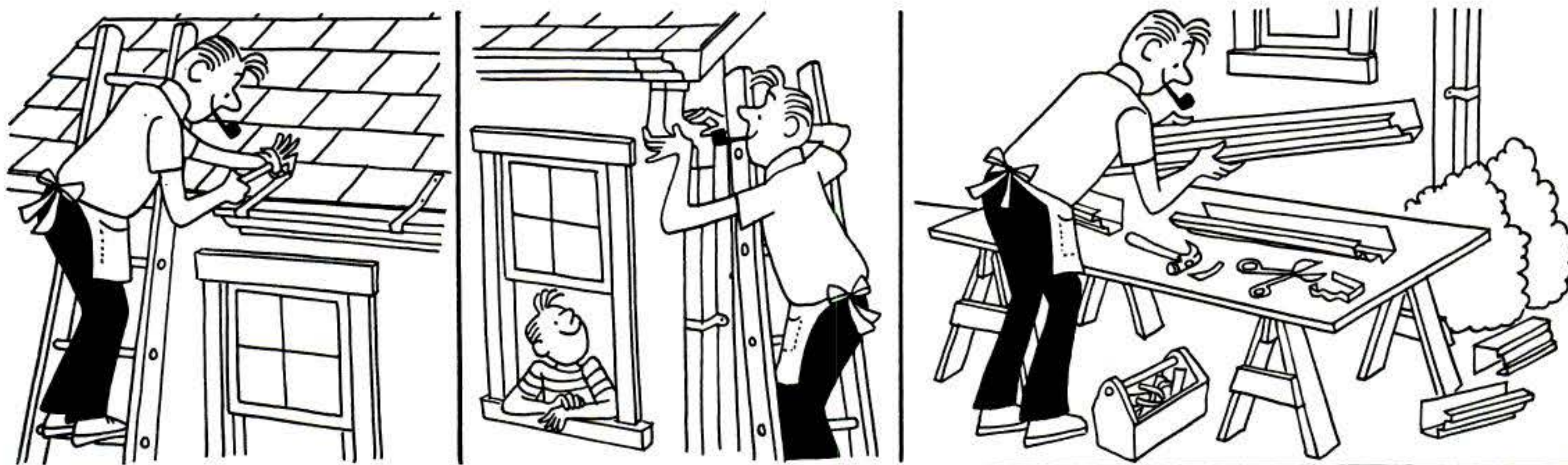
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By ROY DOTY

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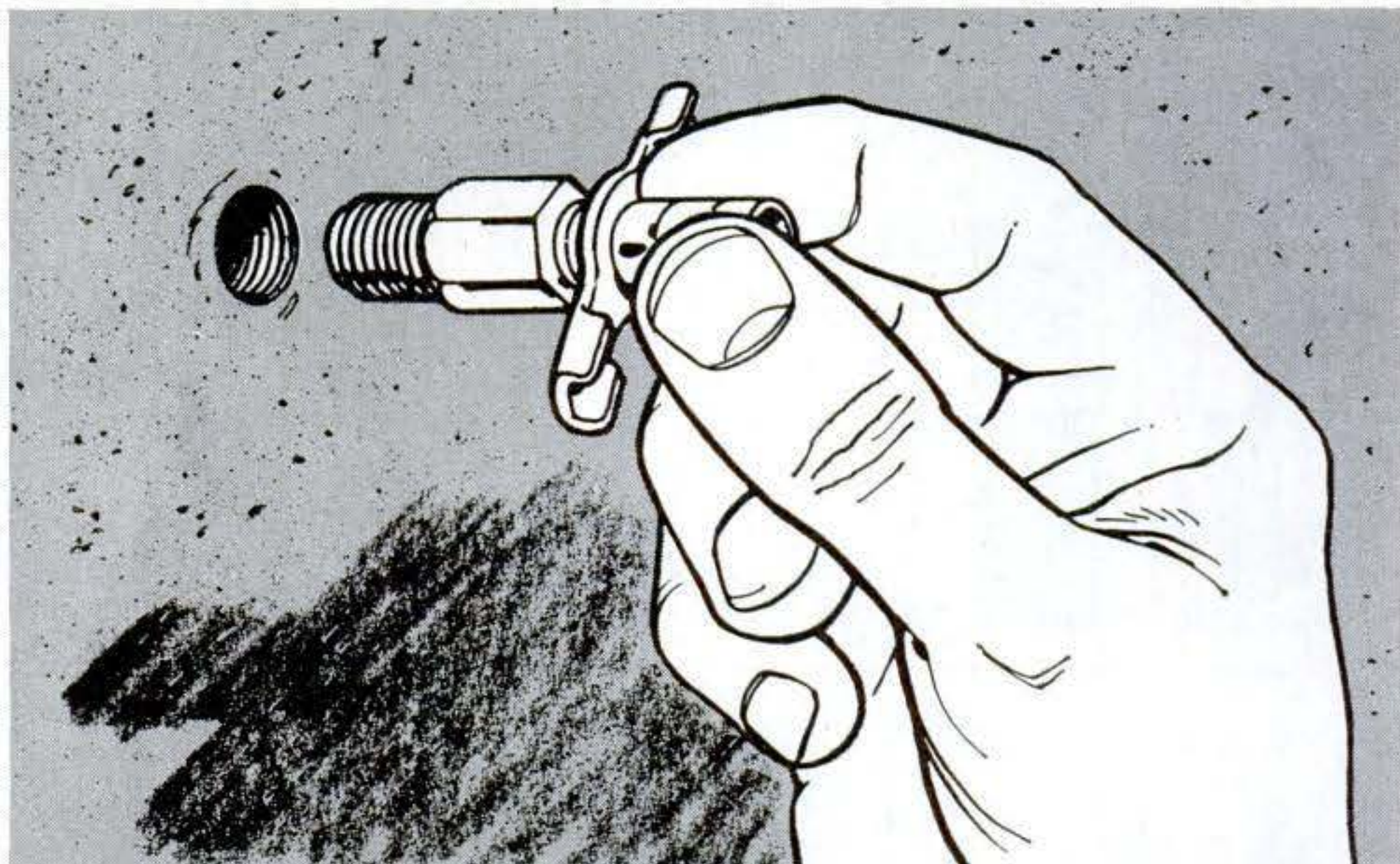


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By RAY HILL

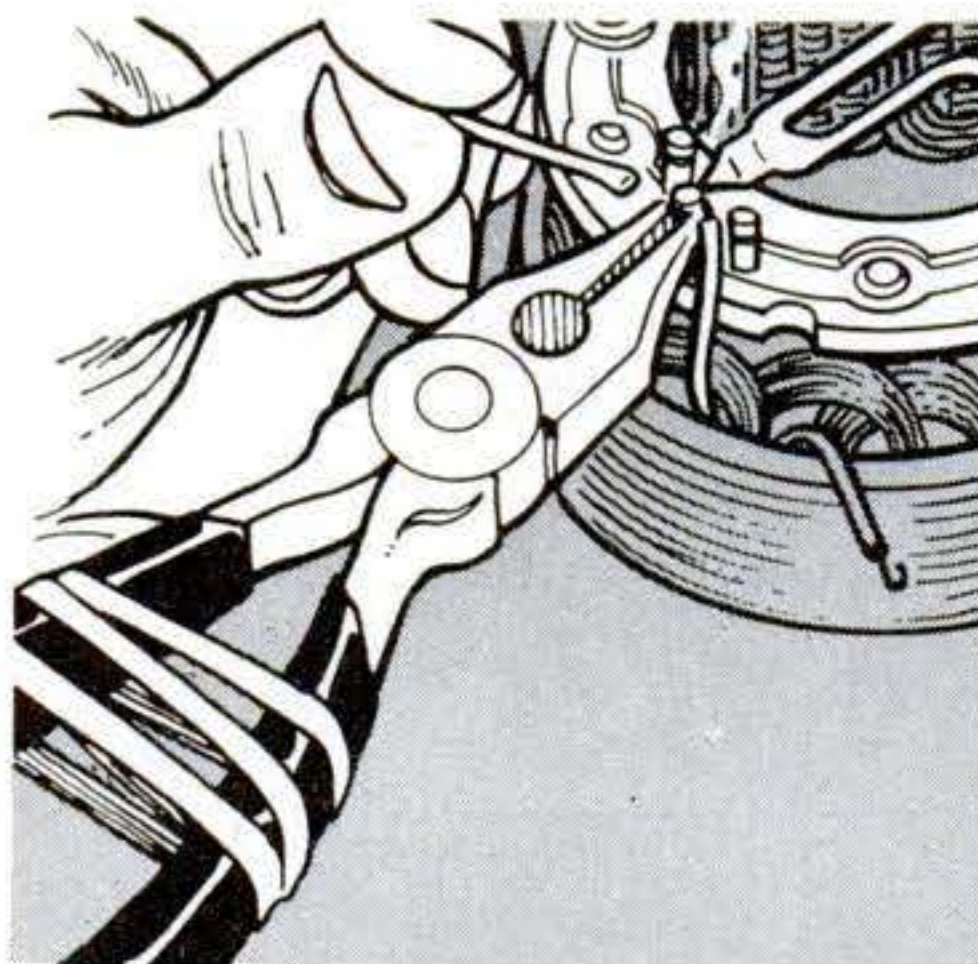
Got a useful car tip? Send it (with Social Security No.) to Car Care, Popular Science, 380 Madison Ave., New York, N.Y. 10017. We'll pay you \$25 if we use it. If two or more readers send in the same usable tip, the one with the earliest postmark will be chosen. Sorry, but tips can't be returned.



Radiator petcock makes draining the block easier

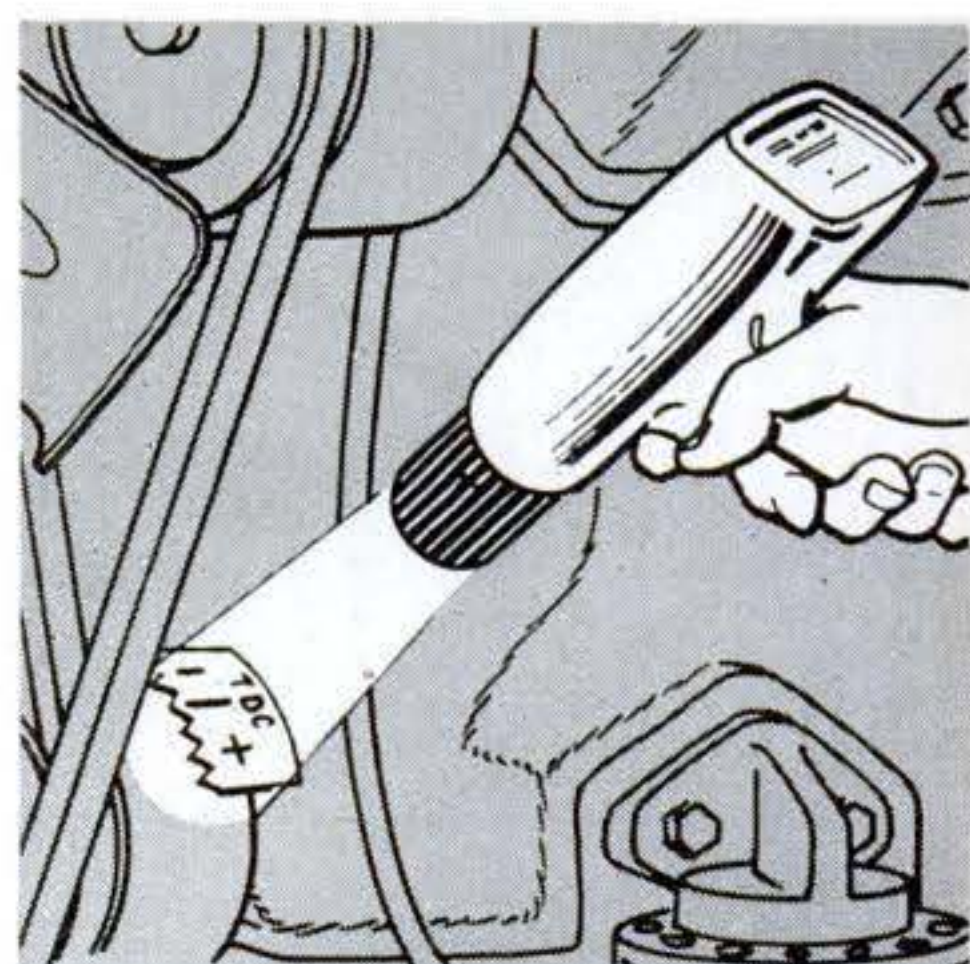
Every two years you should drain the cooling system, flush it, and pour in fresh coolant. Installing a radiator drain petcock in place of the block drain plug simplifies draining, since loosening a valve is easier than removing and replacing a plug. To loosen, simply turn the valve counter-clockwise with a pair of pliers. To tighten, turn it the other way. If your engine has two drain plugs—one for each side of the

block—you'll need to replace both plugs. When installing the petcock, first screw it in finger tight (no gasket sealer is needed on the threads), being careful not to cross-thread it. Then finish tightening with a wrench of the proper size. Don't overtighten: The petcock uses pipe threads, and some threads will still be showing after it is fully tightened. Petcocks can be purchased at auto-parts supply stores.



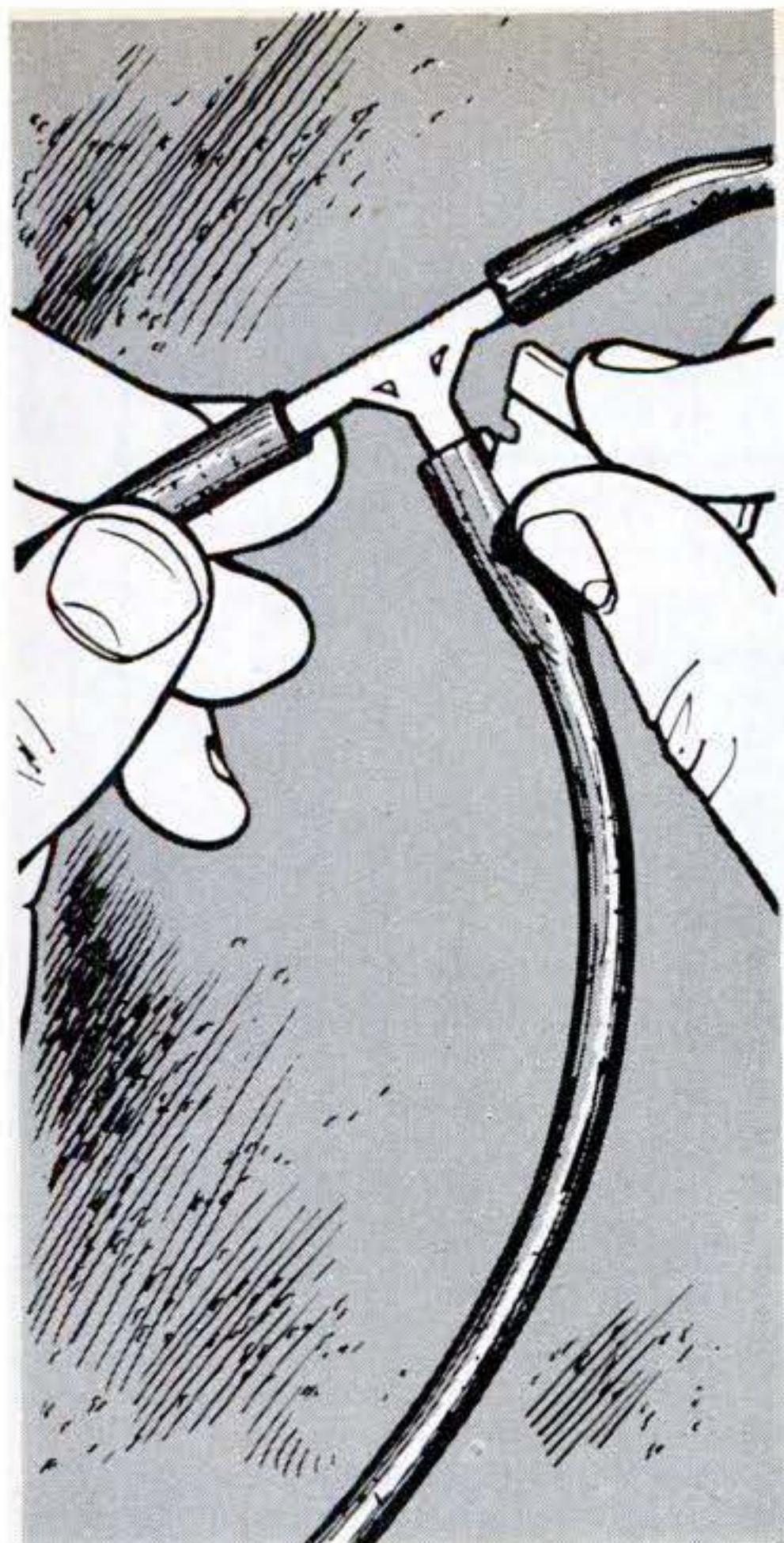
Heat sink for soldering

When unsoldering or soldering a diode lead (in some alternators), use a heat sink to prevent damage. A pair of pliers makes an excellent heat dissipater. Place the pliers close to the connection to be soldered, and use a rubber band to hold the jaws together. This leaves both hands free to work. Never use acid-core solder flux on electrical connections—use only rosin-core solder (electrical solder).



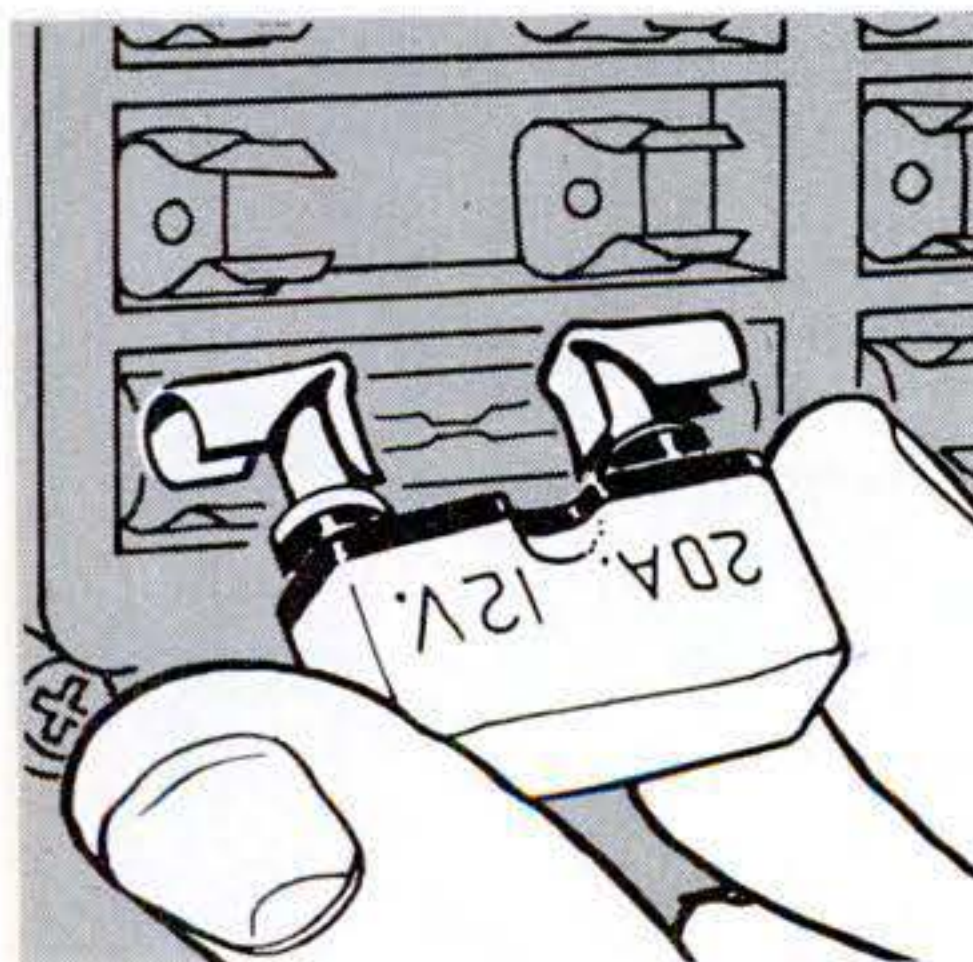
Adjusting ignition timing

On today's engines with their many emission controls it's especially important to follow proper procedures when adjusting timing. Follow the car maker's recommended procedure exactly. This usually includes several steps, one of which is to set engine rpm with a tachometer. Failure to use a tach can result in various problems including lack of power, hard starting, pinging, and reduced mpg.



Removing vacuum lines

Many vacuum lines under the hood are attached to plastic connectors. If removing a hose from one of these is difficult, don't force it. You may break the connector. Slit the end of the hose lengthwise with a single-edge razor blade and peel it off. If it's hard and brittle, replace it with a new hose. If not, cut off the damaged end before reconnecting it. You can get new hoses at auto-parts stores.

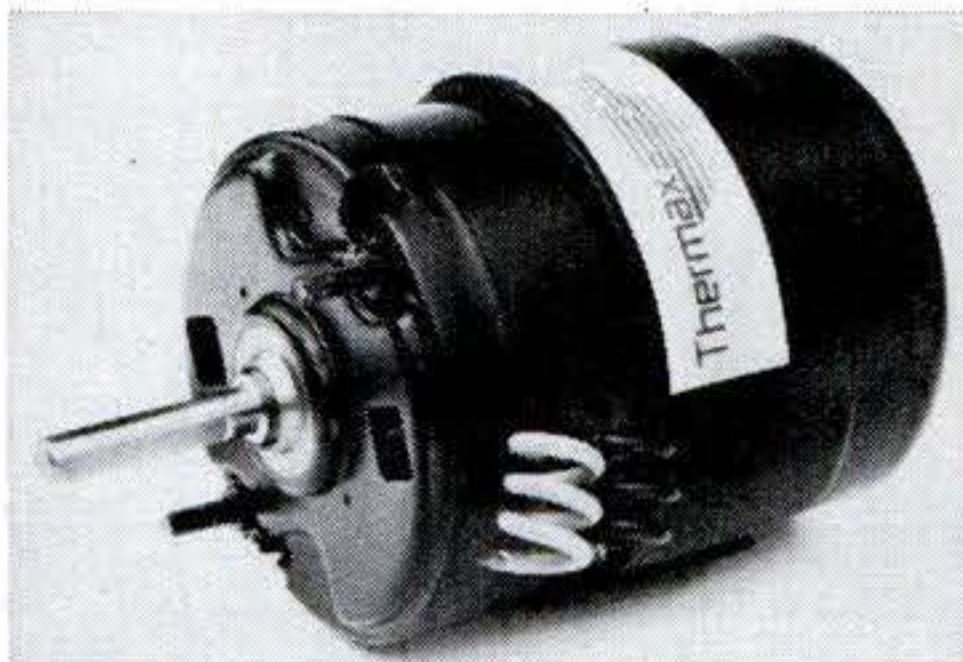


Trouble-shooting a blown fuse

Usually, replacing a blown fuse with a new one is all that's necessary. But if the new fuse blows immediately, detective work is called for. To save fuses, install a circuit breaker (of the same amp rating as the blown fuse) while tracking down the cause of the problem. It will click when the circuit breaks. When the breaker cools, the circuit will be automatically completed again. This makes the job a lot easier.

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It was tempting at the time to turn to "small" automotive alternators — which need several thousand rpm to generate the kind of voltage we wanted. They are large, heavy and also require an efficiency-killing step-up pulley to achieve the necessary rpm to generate power from a small water wheel or windmill.

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Meanwhile, the price of oil and other fuels was just starting to skyrocket. Many energy-conscious people had made up their minds not to take these price hikes lying down. More and more people were thinking seriously of switching to **free** renewable energy sources — solar, wind, water — simply because it had begun to make good economic sense. Needing to produce exactly the right product for the growing boom in home-sized alternate energy products, Thermax engineers started from scratch to design the perfect small generator. It had to be inexpensive, light, and operate efficiently at low rpm (which no other small generator could do).

The result was the TC25G permanent-magnet dc generator — which may be exactly the generator you've been looking for. At the Energy Lifestyle Show, visitors who tried our demonstration generator were so amazed by its sensitivity that some even looked underneath to see if there was a trick to it! Many enthusiasts bought generators on the spot.

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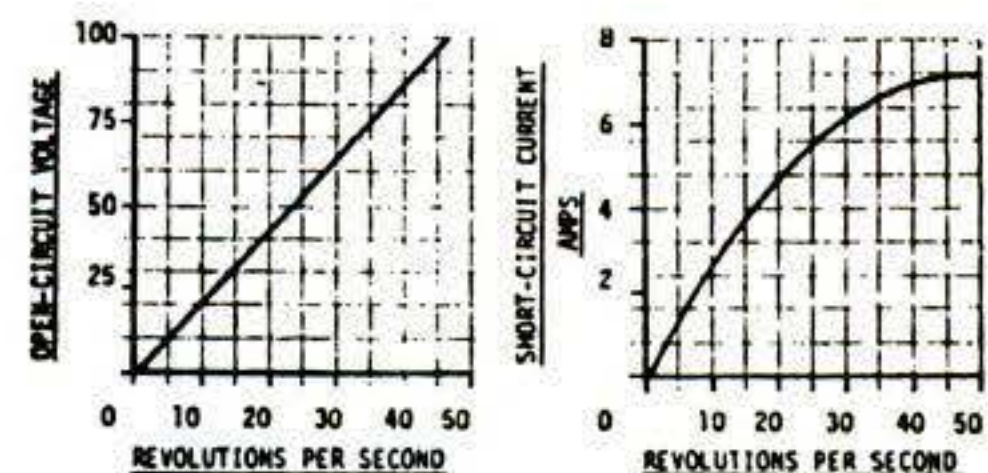
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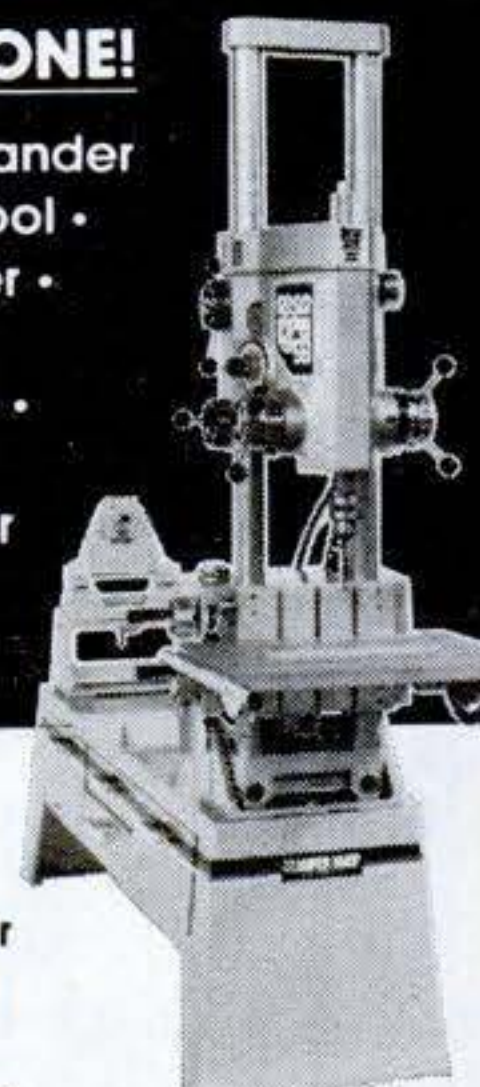
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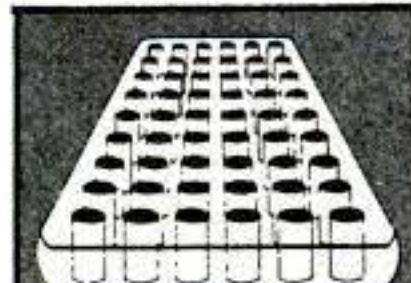
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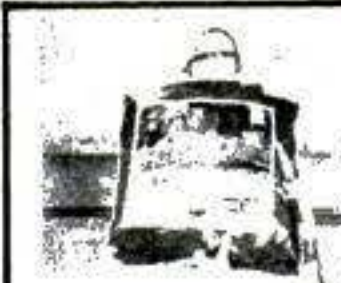
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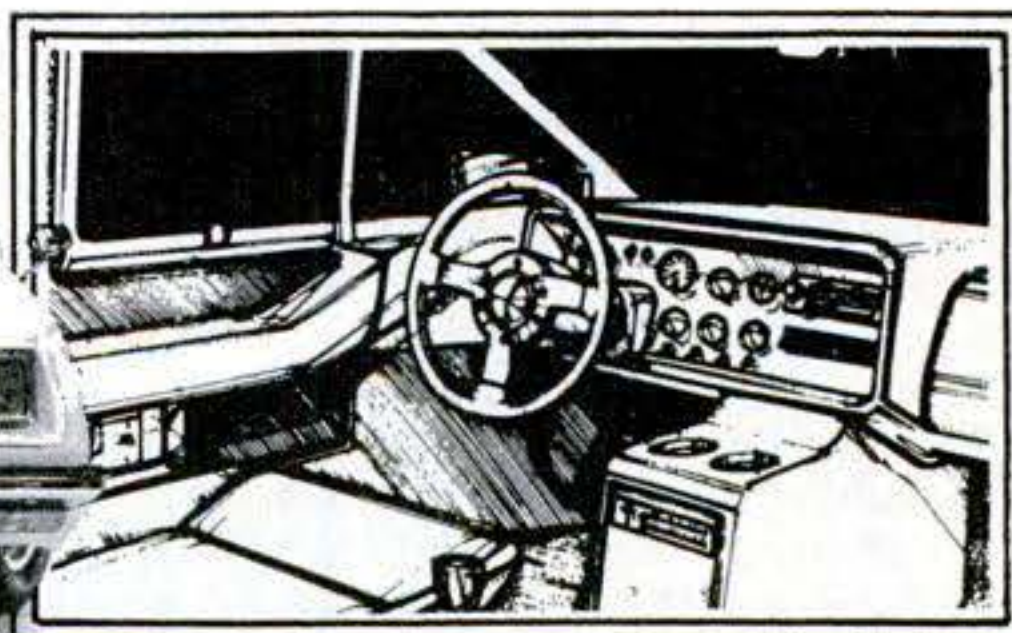
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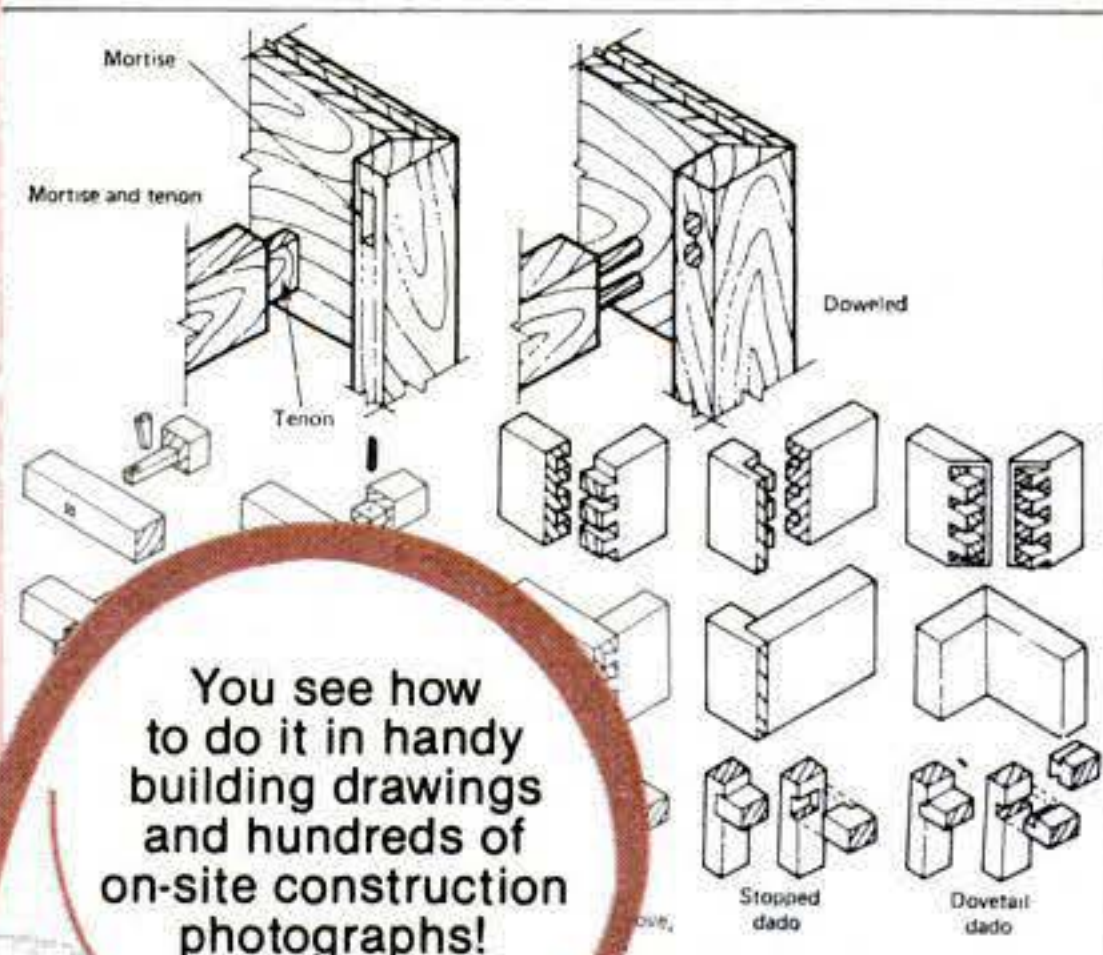
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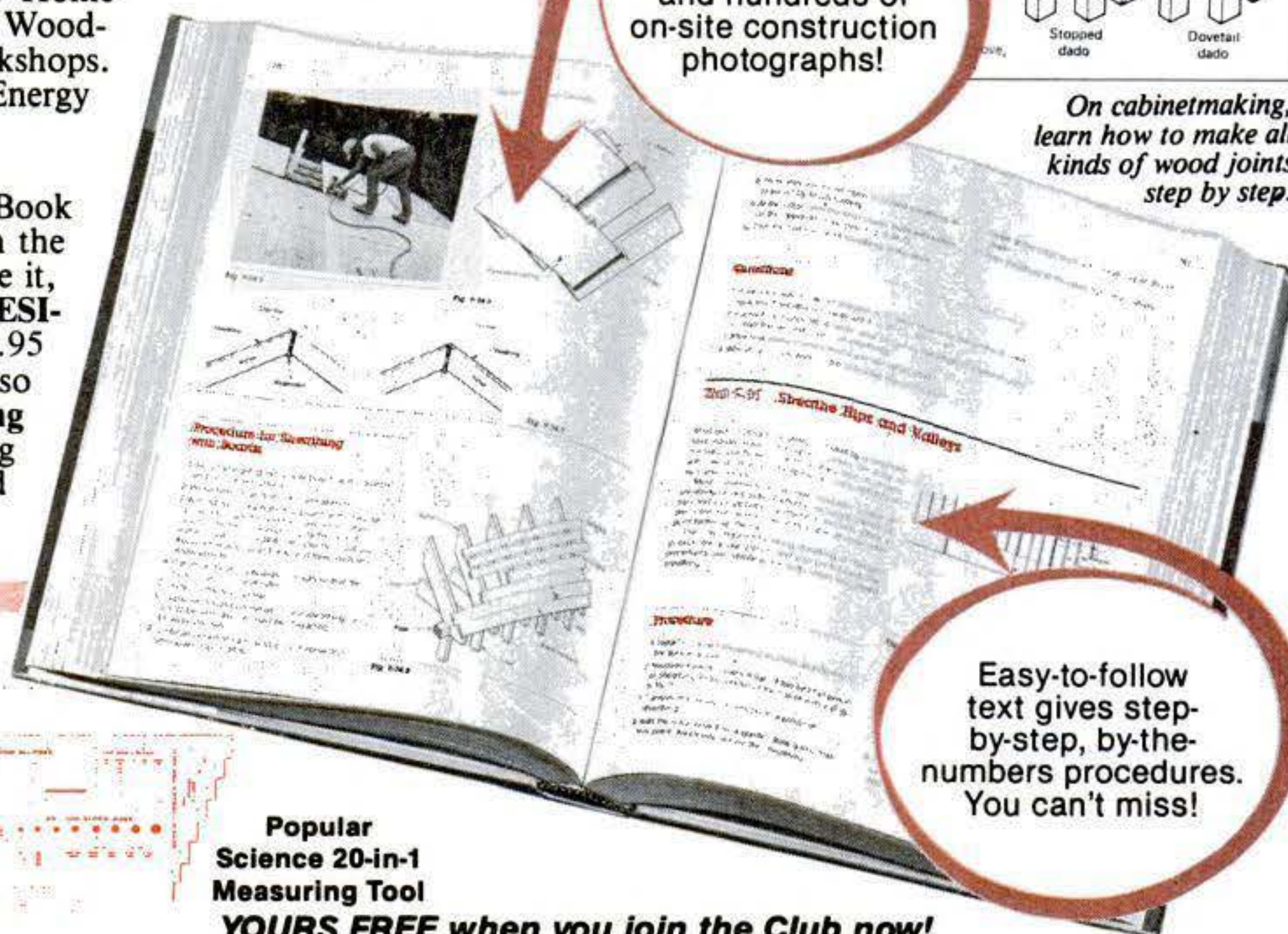


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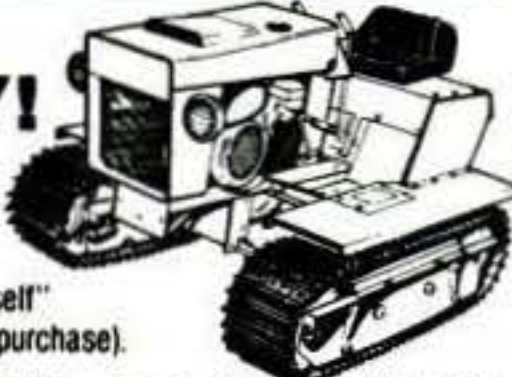
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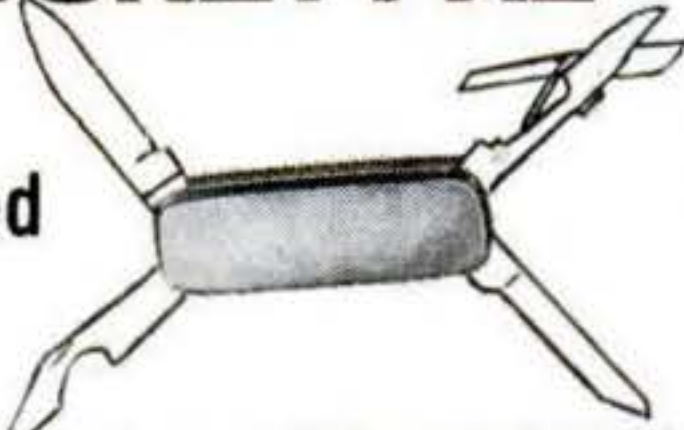
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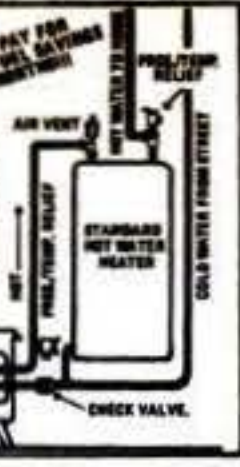
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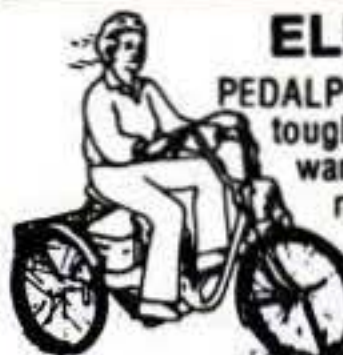
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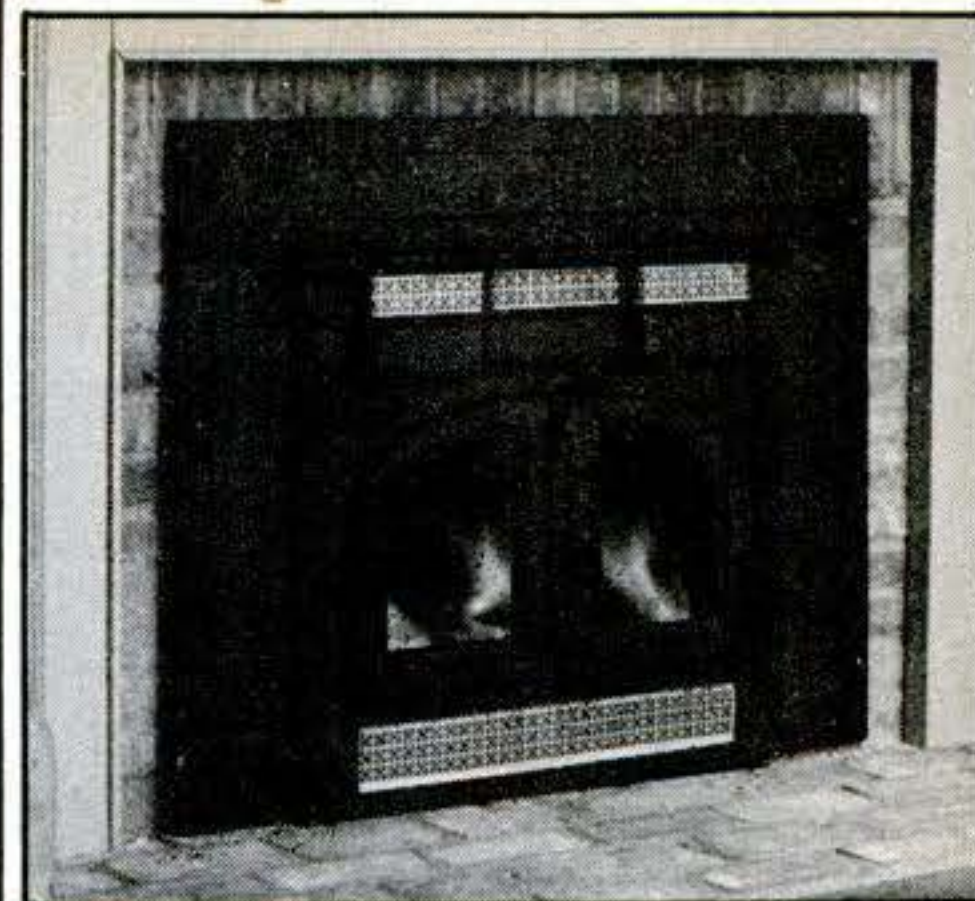
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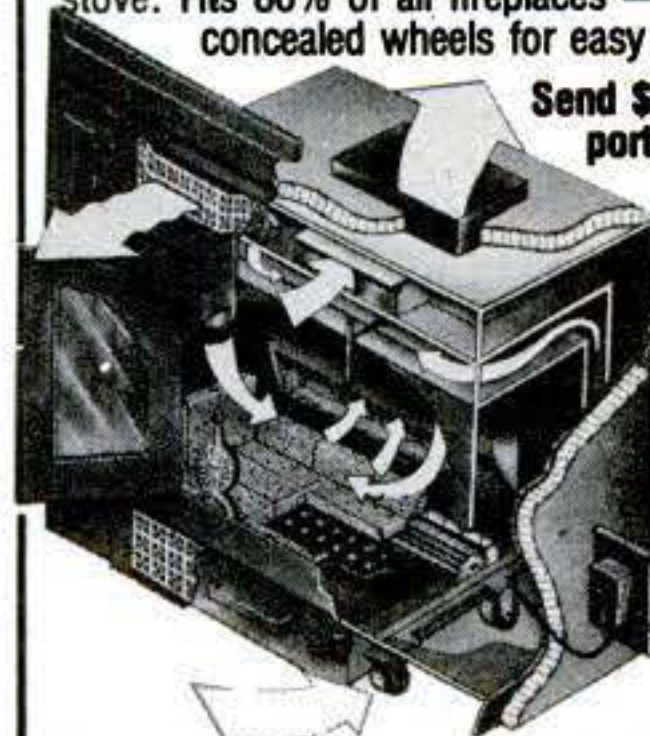
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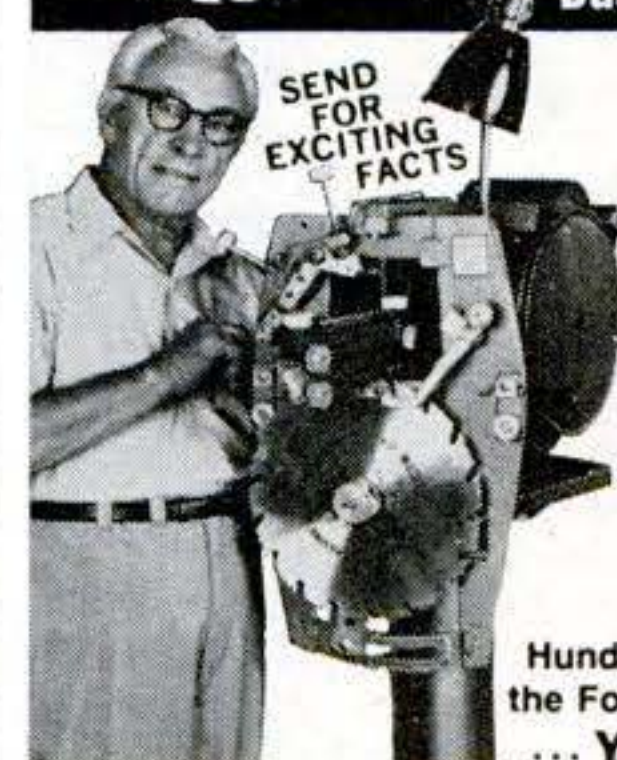
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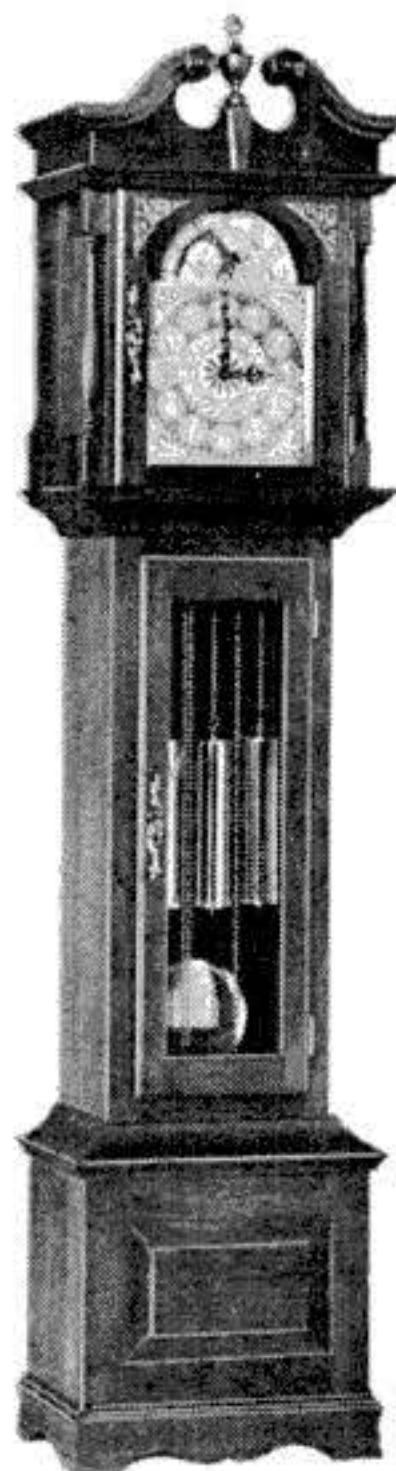
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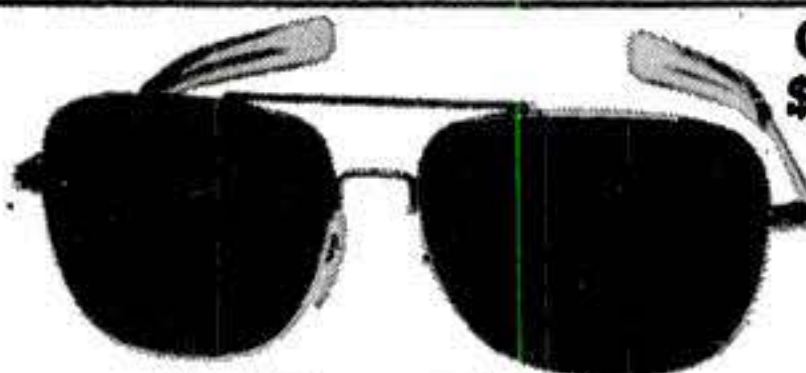
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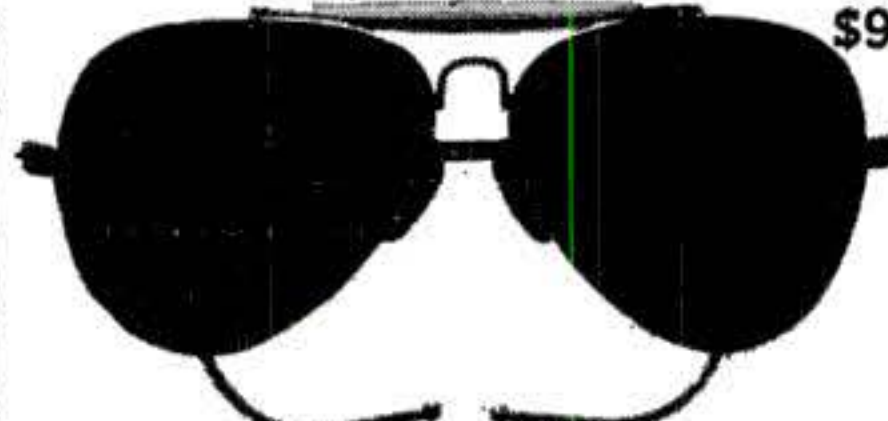
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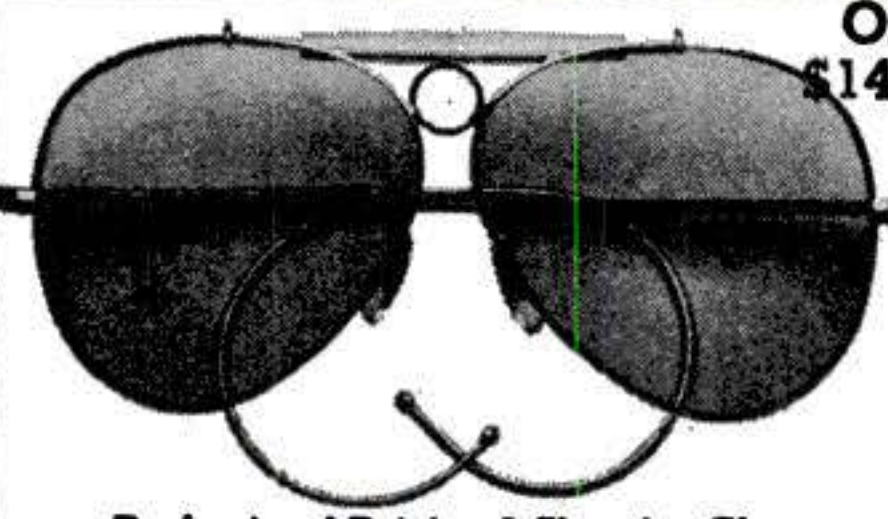
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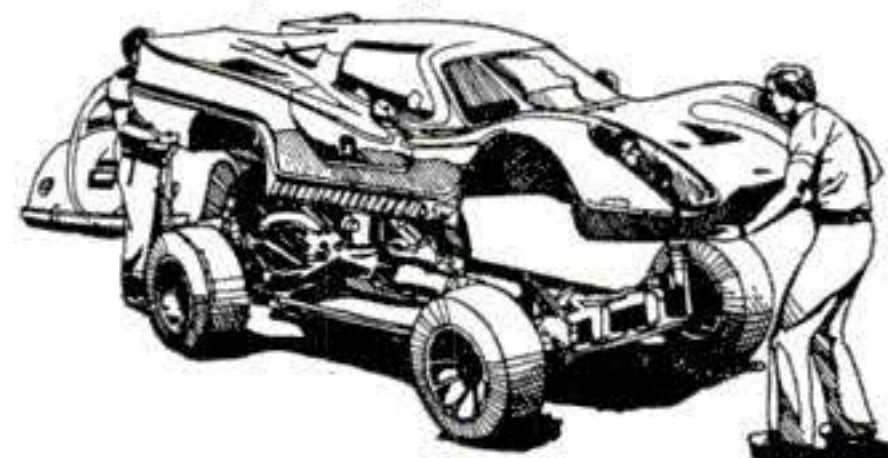
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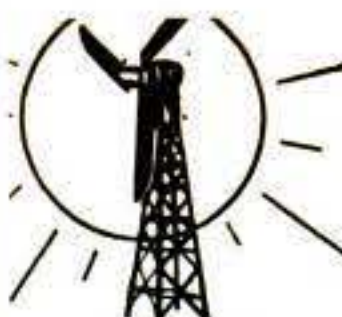
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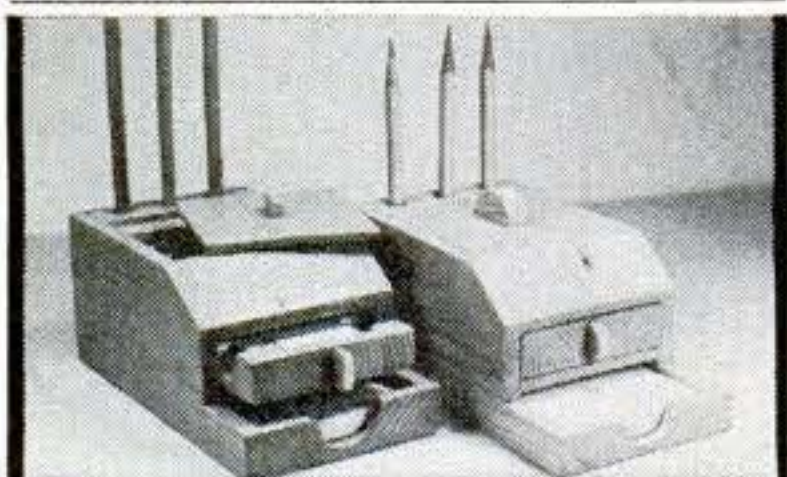
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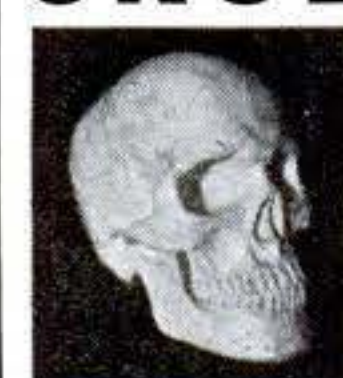
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Not sold in California.

World's First and Only Solar-Powered Watch*

Guaranteed to outperform any watch sold today... or costs you nothing!

The Sunwatch; acclaimed as the most accurate, most versatile, most rugged watch ever made.

These features make all other watches obsolete:

- Clearly visible by day or night
- Natural side-view window simplifies reading
- 100% solar-powered, you never replace batteries
- No resetting of calendar, not even in leap years

Space age accuracy

Now you'll never worry about accuracy again. Because the Sunwatch will keep you on time for the rest of your life. (Accurate to within 1 sec. per month.)

Solar age efficiency

Miniature solar cells automatically convert sunlight, daylight or ordinary bulb light into usable energy for storage. The solar cells last virtually forever. So you'll never replace a watch battery again.

Programmed for over a century

The built-in computer on a chip will always display the correct time date and month. Also, it automatically adjusts the watch calendar for long and short months, leap years and it's programmed until the year 2100!

Easy to read

The natural side-view display lets you tell the time, day and date without twisting your arm into an uncomfortable position.

Numbers always visible

Four varying light intensities are built into the viewing display, allowing the Sunwatch to adjust automatically to any light. This means you can always read it, even in the brightest sunlight.

10 Display functions

The Sunwatch is capable of displaying the following information: hours • minutes • seconds • months • date • day • leap year • speed calibration • AM/PM indicator • seconds count-off.

Extreme accuracy

Unlike other electronic watches using tuned crystals to control timing accuracy, the Sunwatch incorporates a unique, programmable, microcircuit synthesizer to make it the first watch in history that is accurate to less than 1 second per month. That's 5 times more accurate than the latest quartz Accutron.

The Power Source

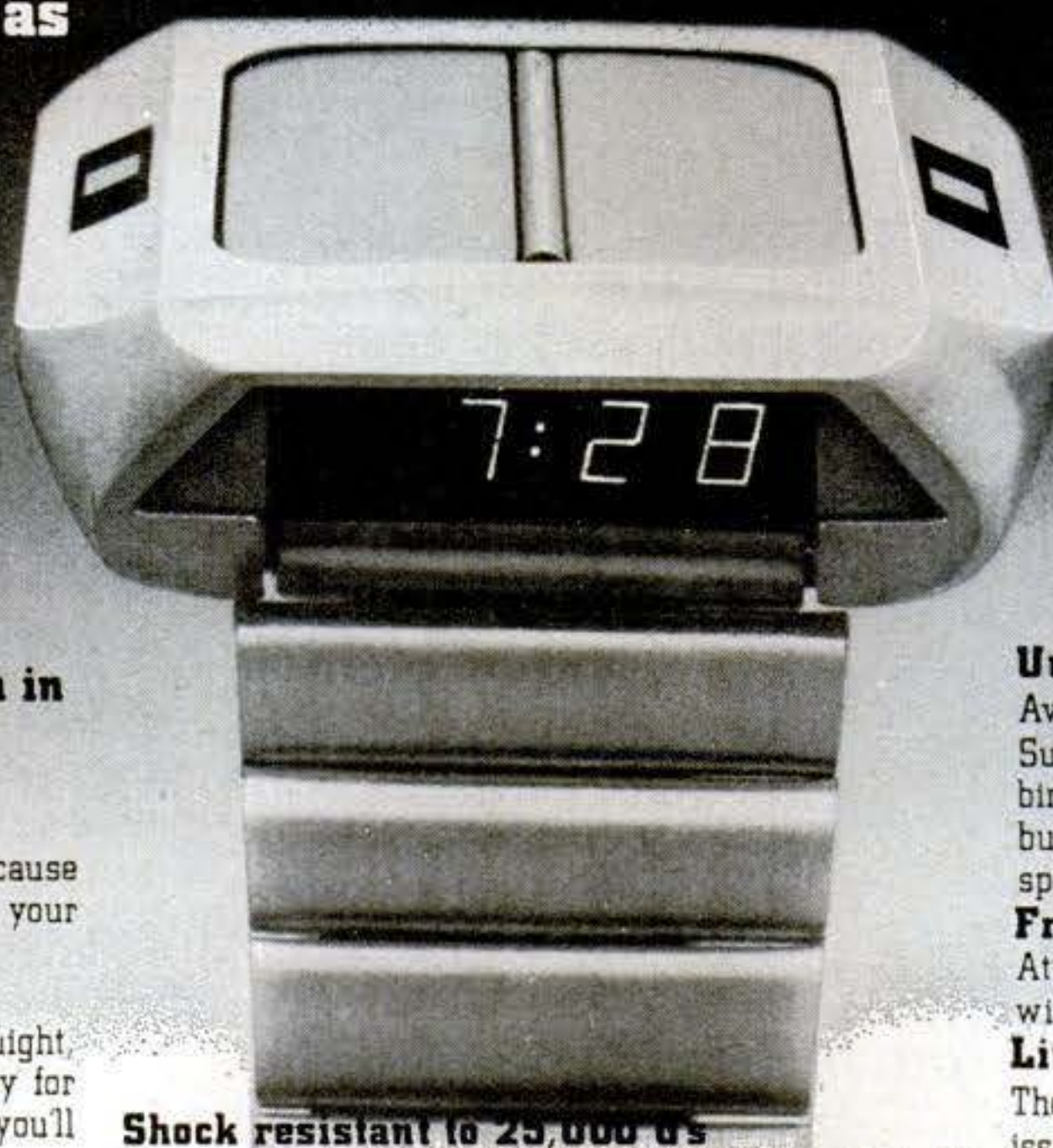
Tiny silicon power cells, which are constantly being energized by natural sunlight, daylight or an ordinary light bulb keep the Sunwatch energy storage system charged. Should the watch not be exposed to light, it will continue to operate for months on stored power.

The most indestructible watch in the world

The workings of the watch: solar panels, energy cells, quartz crystal, computer on a chip, etc., are all permanently sealed in a Lexan module. This module is so unique it's protected by U.S. and foreign patents.

Completely waterproof

Leave the Sunwatch in salt water for months. Dive with it in depths up to 750 feet. There are no openings — magnetic slide bars activate all functions. With Sunwatch's exclusive, permanently sealed Lexan module, there are no "O" rings or seals to leak.



Shock resistant to 25,000 G's

You can crash it into a rug-surfaced brick wall at 90 mph with no noticeable effect. Wear it while doing heavy work, exercise or any strenuous activity.

Temperature resistant

Put the Sunwatch in boiling water for 30 minutes, freeze it in a block of ice for a year. Extreme temperatures will not damage your Sunwatch.

Pressure resistant

There are no air spaces inside the Sunwatch. Therefore, it is not susceptible to high pressures such as might be encountered diving to great depths.

The perfect watch for a lifetime

Imagine split-second accuracy for the rest of your life. Sunwatch is a virtually indestructible, beautifully styled, space-age timepiece, and it's available in three exciting finishes: Brushed stainless steel, Gold tone stainless steel, or a Durable black finish on stainless steel. All Sunwatches come with a matching stainless steel band with removable links and adjustable clasp.

Made in the United States

The Sunwatch, designed by Roger Riehl, was being worn by its inventor nearly a year before the first electronic digital watch was even available to the general public. Since that time constant engineering evaluations and design improvements have been made on the Sunwatch to incorporate the latest in digital microcircuit and solar power technology. Thus the Sunwatch today represents state-of-the-art electronics technology. It is built to the same rigid standards practiced by the manufacturer in creating sophisticated computer microcircuits for the U.S. Government and other major users of these components.

* A word about other "Solar Watches"

Roger Riehl, designer of the Sunwatch, states that there is no other completely solar powered watch on the market today. Claims of solar power by other watch manufacturers are based on the use of a small solar cell. Due to their limited size, these cells can be proven, in technical terms, to be of virtually no significant value in extending the life of a watch battery. For this reason, all other so-called "solar watches" must have replaceable batteries. The Sunwatch's power storage system, however, need never be changed and is, in fact, permanently sealed to withstand abuse and the elements.

Unique and memorable gift

Available in a special gift box (see order form) the Sunwatch makes an ideal gift for special holidays, birthdays, graduation, Father's Day, etc. Perfect for business people, commuters, teachers, athletes and sportsmen, who require split second accuracy.

Free custom engraving

At your request, each Sunwatch will be hand-engraved with the name you specify.

Limited Warranty is your protection

The Sunwatch is covered by a 2 year limited warranty issued by Riehl Time Corporation (manufacturers of the prestigious Synchronar 2100) and included with your watch. A copy of the warranty may also be obtained free of charge by writing to Riehl Time Corp., 53 S. Jefferson Rd., Whippany, NJ 07981. This warranty gives you specific legal rights, and you may have other rights which vary from state to state.

15 Day no risk trial offer

Order your Sunwatch today and use it for 15 days. Then, if you are not completely satisfied return it for full money back.

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Please add \$3.95 per watch shipping and insurance. Enclosed is \$ _____ Check or Money Order (N.J. Residents add appropriate sales tax)

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